ORTEC®

Micro-Detective®
Detective®-200

Portable Neutron and Gamma Nuclide Identifiers

User's Manual

Software Version 3.1

Printed in U.S.A. ORTEC Part No. 931046 0714
Manual Revision G

Advanced Measurement Technology, Inc.

a/k/a/ ORTEC®, a subsidiary of AMETEK®, Inc.

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If it becomes necessary to return this instrument for repair, it is essential that Customer Services be contacted in advance of its return so that a Return Authorization Number can be assigned to the unit. Also, ORTEC must be informed, either in writing, by telephone (865.482.4411) or by facsimile transmission (865.483.2133), of the nature of the fault of the instrument being returned and of the model, serial, and revision ("Rev" on rear panel) numbers. Failure to do so may cause unnecessary delays in getting the unit repaired. The ORTEC standard procedure requires that instruments returned for repair pass the same quality control tests that are used for new-production instruments. Instruments that are returned should be packed so that they will withstand normal transit handling and must be shipped PREPAID via Air Parcel Post or United Parcel Service to the designated ORTEC repair center. The address label and the package should include the Return Authorization Number assigned. Instruments being returned that are damaged in transit due to inadequate packing will be repaired at the sender's expense, and it will be the sender's responsibility to make claim with the shipper. Instruments not in warranty should follow the same procedure and ORTEC will provide a quotation.

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ADDITIONAL WARRANTY STATEMENT

Please note that the integrated computer that controls the Detective is intended exclusively for the tasks detailed in this *User's Manual*. Using this computer for any other purpose ***could void your warranty***.

In addition, the Detective contains ***no user-serviceable parts***. Except for the battery hatch on the left side panel, which can be opened when the battery requires replacement, breaking the seal on the case ***voids your warranty***. The Detective should be opened only by ORTEC-authorized service personnel.

If you have any questions about the use or maintenance of this instrument, please contact your ORTEC representative or our Global Service Center first.

IMPORTANT

The Detective is designed to function with the Regional Settings in Microsoft® Windows® Mobile™ set to the English (United States) region and all of its default settings, as discussed in Section 7.11. ***Using other than the factory default settings can cause operational problems.***

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TABLE OF CONTENTS

WARRANTY ii

ADDITIONAL WARRANTY STATEMENT iii

Safety Instructions and Symbols ix

Cleaning Instructions ix

1. INTRODUCTION 1
   1.1. Monitoring Modes 1
   1.2. Hardware Features 3
   1.3. How This Manual Is Organized 4
   1.4. Spectrum and Search File Storage, Transfer, and Viewing 5
      1.4.1. Saving Spectra and Searches 6
      1.4.2. File Formats and Filenaming Conventions 6
         1.4.2.1. Identification Mode Spectra 6
         1.4.2.2. Search Mode “Strip Charts” 7
         1.4.2.3. The Background File 7
   1.5. A Note About the Detective-200 User Interface 7
   1.6. The “Launcher” Interface for Multiple Identifier Applications 7

2. GETTING STARTED 9
   2.1. Major System Components 9
   2.2. The Micro-Detective 9
      2.2.1. Front Panel 9
      2.2.2. Rear-Panel Connectors 10
      2.2.3. The Internal Battery 10
      2.2.4. The Touchscreen 11
      2.2.5. Attaching the Carrying Strap 11
   2.3. The Detective-200 12
   2.4. Internal vs. External Power 13
   2.5. Operating Cautions and Notes 13
   2.6. Startup and Cooldown 15
      2.6.1. Connecting the Detective to External Power and Turning It On 15
      2.6.2. Turning On the Mechanical Cooler 16
   2.7. The User Interface 17
      2.7.1. Instrument Status Indicators 17
      2.7.2. Moving Through the Menus 17
   2.8. Customizing the Detective Settings 18
   2.9. Checking the Calibration 19

2.10. Running A New Background After Calibration 22

3. RADIATION MONITORING 23
3.1. Survey (Count-Rate/Dose-Rate) Mode 23
3.2. Identification Mode 25
3.2.1. Start the Identification 26
3.2.2. Extending the Count-to-Preset 27
3.2.3. Save 27
3.2.4. View Found Nuclides List for Classify ID Display Mode 27
3.2.5. Intense (View Highest-Intensity Spectrum Lines) 28
3.2.6. Display Spectrum 29
3.2.6.1. Display Controls 29
3.3. Search Mode 30
3.4. Monitor Mode 31
3.5. SNM Search Mode 32

4. IDENTIFICATION MESSAGES AND RADIONUCLIDE LIBRARY 35
4.1. Comments on Classify Mode Messages 40
4.1.1. Comments on "Found Nuclide" Screen Messages 40

5. ADVANCED SETUP 41
5.1. Advanced Setup — Page 1 41
5.1.1. Status 41
5.1.2. Turn Cooler Off/On 43
5.1.3. Calibrate (Manual) 43
5.1.3.1. Start the Calibration 43
5.1.3.2. Apply the Improved Calibration 44
5.1.3.3. Perform a Background Measurement 45
5.1.3.4. Restore Default 45
5.1.3.5. Back 46
5.1.4. Background 46
5.1.5. List Nuclides (View Analysis Library) 46
5.1.6. Recall Spectra 46
5.1.6.1. Viewing Stored Spectra 47
5.1.6.2. Viewing Stored Spectrum Reports 47
5.1.7. About 50
5.2. Advanced Setup — Page 2 50
5.2.1. Calibration Settings and Auto-Calibration 51
5.2.1.1. Setup Requirements for Successful Auto-Calibration 52
5.2.1.2. Auto-Calibration 53
5.2.2. Background Settings 53

5.2.3. Identify (Identification Mode) Settings 54
5.2.3.1. Real Time Preset 54
5.2.3.2. ID Display Mode 54
5.2.3.3. LCX (Low-Confidence Expert) ID Mode 55
5.2.3.4. Color Coded IDs 55
5.2.4. Settings 56
5.2.4.1. Password 56
5.2.4.2. Allow Display of Spectrum 56
5.2.4.3. GPS Port 57
5.2.4.4. USB Port 57
Data (ActiveSync) 57
Control (MCA Mode) 57
5.2.5. Search Mode Settings 57
5.2.6. SNM Mode Settings 57
5.2.7. Dose-Rate Units and Alarms 59
5.2.8. Adjust Audio Volume (Micro-Detective only) 59
5.3. Advanced Setup — Page 3 60
5.3.1. Remote 60
5.3.2. Exit 60
5.3.3. Spectra 60
5.3.3.1. Ask for Sample Description 61
5.3.3.2. Default Description 61
5.3.3.3. Data Location 61
5.3.3.4. File Save Format 61
5.3.3.5. Delete Stored Spectra 62

6. FILE TRANSFER TO COMPUTER 63
6.1. Windows 7 63
6.2. Windows XP 65
6.3. When File Transfer Is Complete 67

7. TROUBLESHOOTING 69
7.1. “Error Saving .SPC File” Message 69
7.2. If the Detective Program Stops 69
7.3. If You Drop the Detective 69
7.4. If the Detective Will Not Turn On 70
7.4.1. Starting from an Exhausted Battery 70
7.5. If the Display is Lost or Posts a “Display Disabled” Message 71
7.6. If You Forgot the Password 71
7.7. Calibration Issues 71
7.7.1. Calibration Takes Very Long to Complete or Does Not Finish at All 71

7.7.2. The Centroid, FWHM, or Calibration Adjustment Value Has Changed Dramatically Since the Last Calibration . . . 71
7.8. GPS Issues . . . 72
7.8.1. Delayed Display of Location Coordinates . . . 72
7.8.2. "GPS Not Communicating" . . . 72
7.9. Windows Connectivity Problems . . . 72
7.10. Troubleshooting MAESTRO-Related Problems . . . 73
7.10.1. MAESTRO Does Not Connect with the Detective . . . 73
7.11. Other Problems with the Detective . . . 73

8. USING THE DETECTIVE WITH ORTEC SPECTRUM ANALYSIS PROGRAMS . . . 75
8.1. Connecting the Detective to a Computer . . . 75
8.2. Quantitative Analysis of Detective Spectra in GammaVision and ISOTOPIC . . . 76
8.3. MCB Properties in MAESTRO . . . 77
8.3.1. Amplifier . . . 78
8.3.1.1. Gain . . . 78
8.3.1.2. Pole Zero Adjustment . . . 78
8.3.2. Amplifier 2 . . . 79
8.3.2.1. Shaping Controls . . . 79
8.3.3. Amplifier PRO . . . 80
8.3.4. ADC . . . 80
8.3.5. High Voltage . . . 81
8.3.6. About . . . 82
8.3.7. Status . . . 82
8.3.8. Reports . . . 83
8.3.9. Presets . . . 84

9. SPECIFICATIONS . . . 87
9.1. Electrical and Mechanical . . . 90
9.2. Connectors . . . 91
9.3. Computer Prerequisites . . . 92
9.4. Shipping the Micro-Detective or Detective-200 . . . 92
9.5. Long-Term Shutdown/Storage . . . 92

10. CHANGING THE INTERNAL BATTERY . . . 95

INDEX . . . 99

Safety Instructions and Symbols

This manual contains up to three levels of safety instructions that must be observed in order to avoid personal injury and/or damage to equipment or other property. These are:

DANGER Indicates a hazard that could result in death or serious bodily harm if the safety instruction is not observed.

WARNING Indicates a hazard that could result in bodily harm if the safety instruction is not observed.

CAUTION Indicates a hazard that could result in property damage if the safety instruction is not observed.

In addition, the following symbols may appear on the product:

DANGER – High Voltage

ATTENTION – Refer to Manual

Please read all safety instructions carefully and make sure you understand them fully before attempting to use this product.

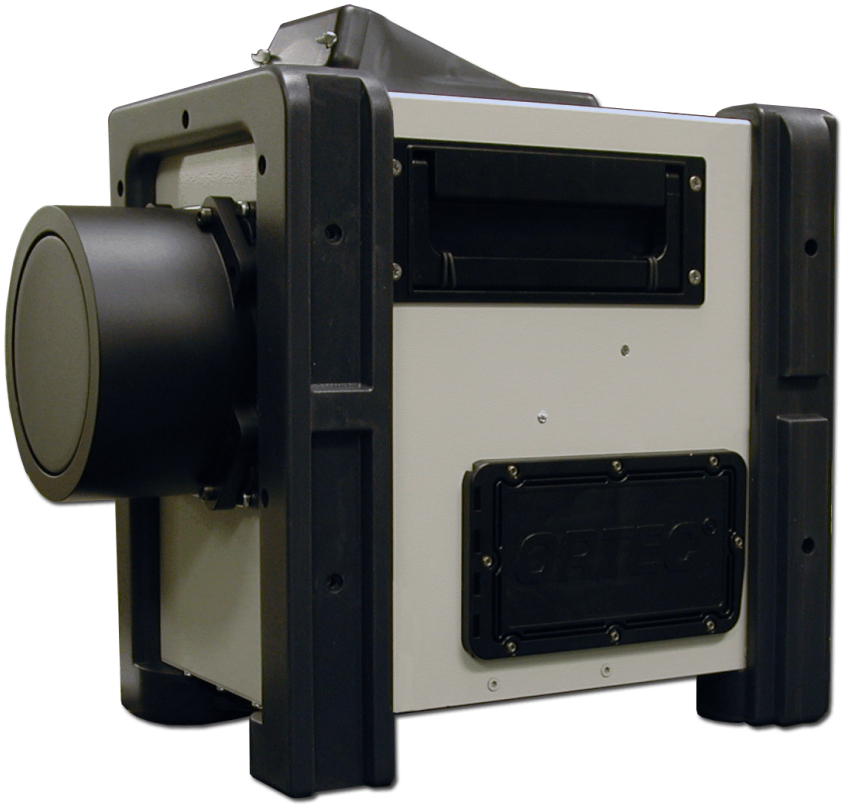
Cleaning Instructions

To clean the instrument exterior:

- Disconnect the instrument from the power source.
- Remove loose dust on the outside of the instrument with a lint-free cloth.
- Remove remaining dirt with a lint-free cloth dampened in a general-purpose detergent and water solution. Do not use abrasive cleaners.

CAUTION	To prevent moisture inside of the instrument during external cleaning, use only enough liquid to dampen the cloth or applicator.

- Allow the instrument to dry completely before reconnecting it to the power source.



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1. INTRODUCTION

The ORTEC Micro-Detective® portable nuclide identifier and its larger, super-sensitive family member, the Detective®-200 transportable identifier, both use a high-purity germanium (HPGe) detector for identification using gamma-ray emissions.[1] The HPGe detector is cooled by a miniature, high-reliability mechanical cooler — no liquid nitrogen is required. The user interface is a high-resolution color touch-screen. The result is a lightweight and rugged instrument that delivers unmatched identification and detection for the needs of nuclear security.

Both instruments identify and classify radionuclides according to the requirements of ANSI N42.34 and other standards. The radionuclide library for this release of the Micro-Detective and Detective-200 is detailed in Chapter 4.[2]

- **Micro-Detective** — At 15 pounds, the most portable member of the Detective instrument family can make an accurate and fast determination without the need for expert human intervention. Nuclide identifications are based on the gamma-ray peaks in the spectrum and on other aspects of the total spectrum.

- **Detective-200** — This latest entry in the Detective family combines the software abilities of the Micro-Detective with an HPGe crystal that is 2.9 times larger in area. At 47 pounds, two people are required to lift it. Use the Detective-200 where ruggedness and sensitivity are more important than light weight, for instance, incident response including emergency portal monitoring; public event surveys for illicit radioactive materials; and configurations such as the ORTEC Detective®-Mobile Radiation Search System, which can be deployed on aircraft, road vehicles, and naval vessels.

NOTE These instruments differ only with respect to their hardware, e.g., the size and weight of the enclosure, the HPGe crystal, and mechanical cooler. Therefore, in the remainder of the manual, the term “Detective” refers to both instruments except where noted.

1.1. Monitoring Modes

The Detective has five radioactivity-monitoring modes; see also the diagram in Fig. 1.

- **Survey Mode** — In this “home screen” mode, the Detective displays gamma count-rate, gamma dose-rate meter (and neutron dose-rate meter, where applicable), a battery-life indicator, and an icon indicating the current power source (e.g., internal battery, power adapter/ charger), detector dead (busy) time, and available disk storage.

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[1]Micro-Detectives may be equipped with an optional moderated neutron detector; the Detective-200 is not.

[2]Other lists of nuclides can be supplied on special order.

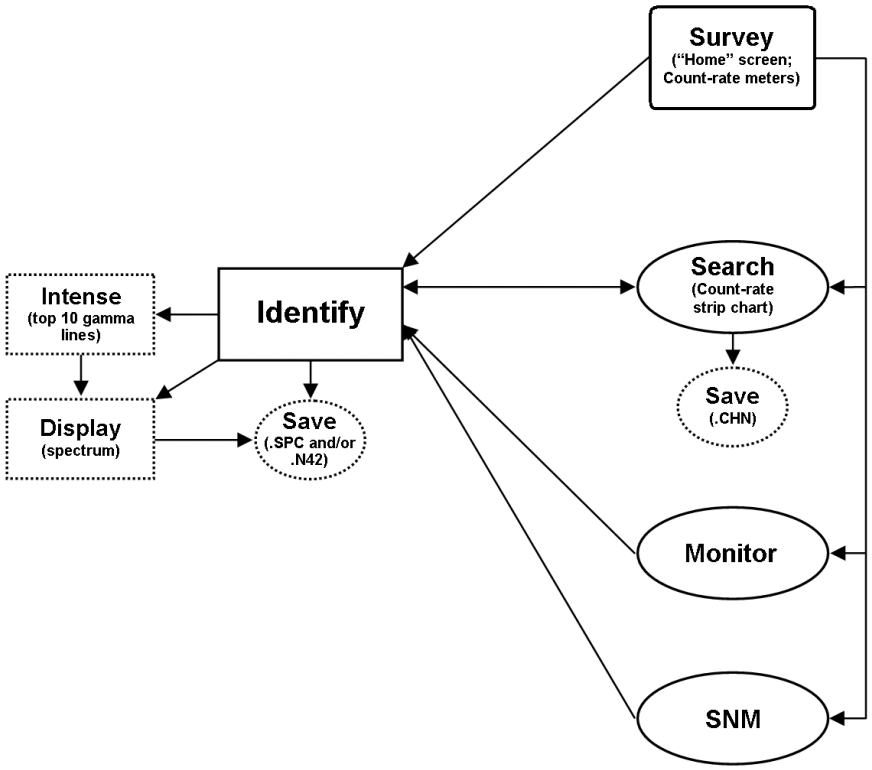

Figure 1. Detective Monitoring Modes.

- **Identification Mode** — This mode is used to identify radionuclides from a stationary object of interest. Data can be collected for an arbitrarily long period to ensure very low false-positive rates. Identifications can be displayed by nuclide name ("ANSI" display mode) or by classification ("Classify" display mode). You can optionally view the spectrum in real time, as well as the 10 most intense gamma-ray lines. The identification results and analysis data can be quickly saved in the .N42 and/or ORTEC .SPC file formats, providing backup for the displayed result and later analysis.[3] For work in sensitive areas, the spectrum display can be disabled.

- **Monitor Mode** — Monitor Mode is used to identify radionuclides while moving relative to object(s) of interest. In this mode, the Detective collects and analyzes a rolling window of the eight most recent 1-second spectra, making it particularly suited to situations where a completely different set of objects may be presented to the instrument in that time period. An example application is an *ad hoc* portal monitor where packages or people pass by the instrument. This mode is also useful as a search tool where the instru-

[3]Measurements with portable identifiers cannot take into account the counting geometry and source shielding, so the Detective does not determine the quantity of the detected nuclides.

ment is carried by the user in an effort to locate and identify a radioactive source. IDs persist until you tap to acknowledge them; this ensures none go unnoticed.

- **Search Mode** — Search Mode makes it easy to find the areas of highest radionuclide activity, that is, places where Identification Mode should be used. The display shows the total gamma-ray count rate (and total neutron count rate, where applicable) in each time period of the last 221 time periods in a rolling "strip chart" display. The time period is selectable. The gamma dose rate (and neutron count rate, where applicable) is also displayed. These strip-chart data can be saved on disk in the ORTEC .CHN file format.

- **SNM Search Mode**[4] — This mode lets you quickly sense the possible presence of special nuclear materials ^{235}U and ^{239}Pu, even if other radioactive materials are present. It is designed for rapid area searches as well as fast scanning of containers or vehicles. Use it to locate possible SNM, then test more rigorously using Identification Mode. SNM Search Mode also takes advantage of the fact that the comparatively innocuous ^{133}Ba can be used as a plutonium surrogate. Advanced users can choose to enable a "search for ^{133}Ba" feature within SNM Search Mode both for training purposes and for developing a site's concept of operations.

In all modes, visual (and audible for the Micro-Detective) alarms warn you of the high radiation field when the gamma dose rate exceeds 10,000 μSv/hr (1 rem/hr); or the neutron count rate exceeds 500 cps on models so equipped. You can optionally set the alarm threshold(s) lower.

1.2. Hardware Features

- The Detective's integrated computer runs under Microsoft® Windows® Mobile™, with the Detective as the only program running. The operation of the software is controlled by soft buttons in much the same way as any other Windows program. A soft keyboard is automatically displayed when any alphanumeric input is needed. The color touchscreen has large soft keys for easy use with bulky gloves, and an audible gamma count-rate signal with adjustable volume. The instrument setup can be viewed and changed to ensure correct operation. A password can be set to prevent changes to the setup parameters on the second and third pages of Advanced Setup dialog, which is accessed by tapping the **Advanced** button.

- Battery-powered operation:

  — The Micro-Detective is completely self-contained and portable, and comes with a power adapter/charger. It can operate for >3 hours on its internal lithium-ion battery.

[4]Patent pending.

The car accessory connector (included) allows you to use 12 V power from an automobile battery. In addition, ORTEC offers optional battery belts to extend the remote operation time.

— The Detective-200 can operate for >2 hours on its internal lithium-ion battery. Like the Micro-Detective, it comes with a power adapter/ charger and 12 V car accessory connector, and can run on an optional battery belt.

- Checking the Detective's calibration is easy, no matter where you are. The Detective allows you to choose the calibration source that best suits your needs — even the ^{40}K naturally present in concrete or low-sodium salt substitute.

- The Detective includes global positioning (GPS) hardware, and where GPS signals can be detected, the upper-right corner of the screen includes the current latitude and longitude, as shown in Fig. 8 on page 17. The GPS coordinates are captured and stored at the start of each identification acquisition, and saved as part of `.SPC` or `.N42` spectrum files. They are available as one of the reports discussed in Section 5.1.6.2.

- The Detective is equipped with IEEE 802.11b wireless connectivity. Third-party software can be used to implement wireless communications (see our technical note, P/N 932735).

Before using the Detective, it must be set up and cooled, and the calibration checked according to the steps in Chapter 2.

1.3. How This Manual Is Organized

This release of the Detective software combines the "operator" and "administrator" functions into one manual. Chapters 2 and 3 cover topics germane to everyday radiation monitoring tasks. The remaining chapters are aimed more at administrator-level users and expert spectroscopists.

"Operator-oriented" chapters:

- Chapter 1 — System features, spectrum storage, file formats, and filename conventions.
- Chapter 2 — Unpacking, startup, operating limits, initial configuration, and user-interface overview.
- Chapter 3 — Using the Detective to monitor and identify radiation sources.
- Chapter 4 — Radionuclide library.

"Administrator-oriented" chapters:

- Chapter 5 — Administrator-level setup features.
- Chapter 6 — Transferring survey files to a computer.
- Chapter 7 — Troubleshooting and error messages.

- Chapter 8 — Using the Detective with a computer and ORTEC spectroscopy software.
- Chapter 9 — Specifications.
- Chapter 10 — Changing the internal battery.

1.4. Spectrum and Search File Storage, Transfer, and Viewing

The Detective can store a nearly unlimited number of Identification Mode spectra in the ORTEC .SPC file format, ANSI N42.42 format, or both. Search Mode count-rate "strip charts" can be saved in the ORTEC .CHN format. The background file is in the .CHN format. See Section 1.4.2 for more information on file types and filenaming conventions. For details on saving and viewing Identification Mode spectra and the associated reports, see Section 5.1.6.

The files can be stored on user-supplied, removable Secure-Digital (SD) storage cards[5] or in the computer's My Documents folder; we recommend the storage card option. The number of spectra stored on an SD card depends on the card's capacity. The Detective program automatically creates a Data folder on the card in which spectrum and search files will be stored. The "home" Survey Mode screen has a storage-space-remaining readout. If you try to save to a full SD card, simply insert another card with available storage space (see also Section 7.1).

The background.chn file is stored on the computer in the \Program Files\DetectiveEX folder. If it is moved or deleted, you must perform a new background measurement before the instrument can be used for radionuclide identification.

If you store the spectrum files on SD cards, they can be transferred directly to your computer with an SD card reader and Windows Explorer. Alternatively, files stored on SD card or in the computer's My Documents folder can be downloaded via the USB port to any computer running under Windows 8 or 64- or 32-bit Windows 7 via the Windows Mobile Device Center; or XP® Professional SP3 via ActiveSync®. See Chapter 6 for detailed instructions.

IMPORTANT *Before connecting the Detective to a computer for the first time*, install ActiveSync or Windows Mobile Device Center ***first***. Otherwise, the Detective may not be able to communicate properly with the computer. Be sure to read Chapter 6.

Our MAESTRO® MCA Emulator Software (A65-BW; sold separately) can be used to view the search and identification spectrum files from the Micro-Detective or Detective-200.

[5]Note that the computer also has a CF type II CompactFlash slot. However, the dust cover — which must be in place to prevent contaminating the card slots — blocks full insertion of the CF card.

MAESTRO can also be used to operate the identifier as a multichannel buffer (MCB) with high-resolution HPGe detector, and store the resulting spectra to disk as ORTEC spectrum files. For more information on these operations, see Chapter 8.

1.4.1. Saving Spectra and Searches

The current Identification Mode spectrum or Search Mode "strip chart" is stored in the unit's spectrum memory. If you do not save this spectrum or search by tapping the **Save** button, it will be lost when you exit the screen.

The **Spectra** dialog (Section 5.3.3) lets you select the sample description options, the file storage location, and the file save format(s) for the spectrum and "strip chart" files. It also lets you delete spectrum files one-at-a-time.

1.4.2. File Formats and Filenaming Conventions

The **ORTEC** file format option saves identification spectra and search "strip charts" in the ORTEC .SPC and .CHN formats, respectively. The **ANSI** format option saves in ANSI N42.42 format, which is compatible with the ANSI N42.42-2006 standard; identification spectra and search "strip charts" are formatted for an InstrumentType of **RadionuclideIdentifier** and **PersonalRadiationDetector**, respectively. The **Both ORTEC and ANSI** option saves both file types for each measurement.

1.4.2.1. Identification Mode Spectra

These can be saved on the ID Mode and (spectrum) Display screens.

The .SPC file contains spectrum, calibration, sample description, and analysis results, as specified in the *ORTEC Software File Structure Manual for DOS and Windows Systems* (P/N 753800; hereinafter called the *File Structure Manual*). It also includes the following information:

- For units with neutron detectors, total neutron counts for each acquisition and the neutron count rate at the time the spectrum file is saved.
- GPS location data.
- The type of Detective-series instrument used to collect the data (e.g., Micro-Detective, Detective-200, Detective-EX 100, Detective-DX 100).

The ANSI .N42 file is formatted for an InstrumentType of **RadionuclideIdentifier**. It includes the spectrum, calibration, sample description, and identification results; neutron count rate (if the unit is so equipped); and GPS location log.

The filename format is:

YYYY_MM_DD_hh_mm_sss

1.4.2.2. Search Mode “Strip Charts”

Search Mode data are “strip charts” of count rate vs. elapsed time.

The .CHN format is simpler than the .SPC format, and is described in the *File Structure Manual*.

The .N42 file includes the sample description and a count rate log for the gamma strip chart; the count rate log for the neutron strip chart (if the unit is so equipped); and GPS location log.

The filename format is:

YYYY_MM_DD_HH_MM_SSStype

When saving in the ORTEC .CHN format, two files are saved for each search, one for the gamma count and one for the neutron count; **type** is either **G** for the gamma-ray chart or **N** for the neutron chart.

When saving in ANSI .N42 format, only one file is generated; **type** is **B** indicating that it contains both the gamma-ray chart and (for units so equipped) the neutron chart.

1.4.2.3. The Background File

The background file is saved in the \Program Files\DetectiveEX folder as background.chn, and is overwritten each time the background is updated.

1.5. A Note About the Detective-200 User Interface

The illustrations and text in this manual reflect the user interface for Detectives that have neutron detectors. Note that because the Detective-200 does not have a neutron detector, its user interface does not display neutron count-rate meters, dose alarm controls, search controls, property pages, etc.

1.6. The “Launcher” Interface for Multiple Identifier Applications

ORTEC supports our versatile Detective platform with a wide range of nuclide identification applications. When only one identifier application is installed on your Detective-series instrument, each time the unit is powered on or rebooted, it automatically starts up that application. If

subsequent ORTEC applications are added to your instrument, our easy-to-use application "Launcher" interface runs first, making it easy to switch between the ORTEC identifier programs, and exit to Windows Mobile.

Figure 2 illustrates the Launcher screen for a Micro-Detective with its native Detective program as well as the additional **Micro-trans-SPEC** application installed. Simply tap the desired application name.[6] (Note that the Launcher may have multiple pages if many applications are installed; tap the scroll/paging indicator as needed.)

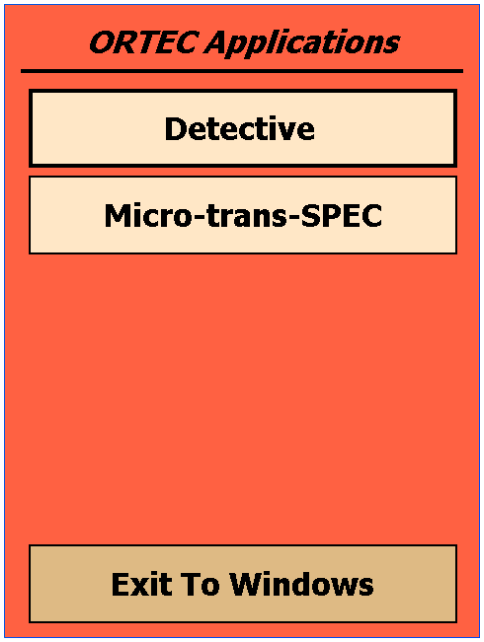

Figure 2. The Launcher Screen.

[6]If the Launcher program does not start automatically, you will instead see the Microsoft® Windows® Mobile desktop. In this case, tap **Start** then **Launcher**.

2. GETTING STARTED

This chapter covers the steps you will need to prepare the Detective for use:

- System components and hardware overview (Sections 2.1 through 2.4)
- Operating cautions (Section 2.5)
- Startup and cooldown (Section 2.6)
- User-interface basics (Section 2.7)
- Customizing the Detective software settings (Section 2.8)
- Initial calibration check (Section 2.9) and background measurement (Section 2.10)

2.1. Major System Components

The specific components for your instrument will depend on the model and options you purchased, but typically they will include a USB cable, the appropriate documentation set, an ac power adapter/charger, and an automobile accessory adaptor for cooling and operating the unit from a 12 V battery.

NOTE If your Detective was shipped in a foam-lined box, instead of a high-impact plastic case, be sure to keep the box and foam and use it for shipping the identifier.

Any options will be packaged separately, and will include instructions for that option.

2.2. The Micro-Detective

Figure 3 shows the Micro-Detective's features.

2.2.1. Front Panel

- **On/Off Button** Located below the touchscreen, on the base of the bezel. To reboot the computer, press the power button. The computer will restart, then automatically launch the unit's software application (the cooler will stay on throughout).

- **SD Card Slot** This is located on the front panel under the protective dust cover. To release the cover, press and rotate by a quarter turn the two captured, bayonet-mount screws. The SD slot is keyed so the memory card can only be inserted in one orientation. Insert the card and close the protective cover.

NOTE *We strongly recommend that the dust cover be fastened in place at all times to protect the card slots from moisture and particulates.*

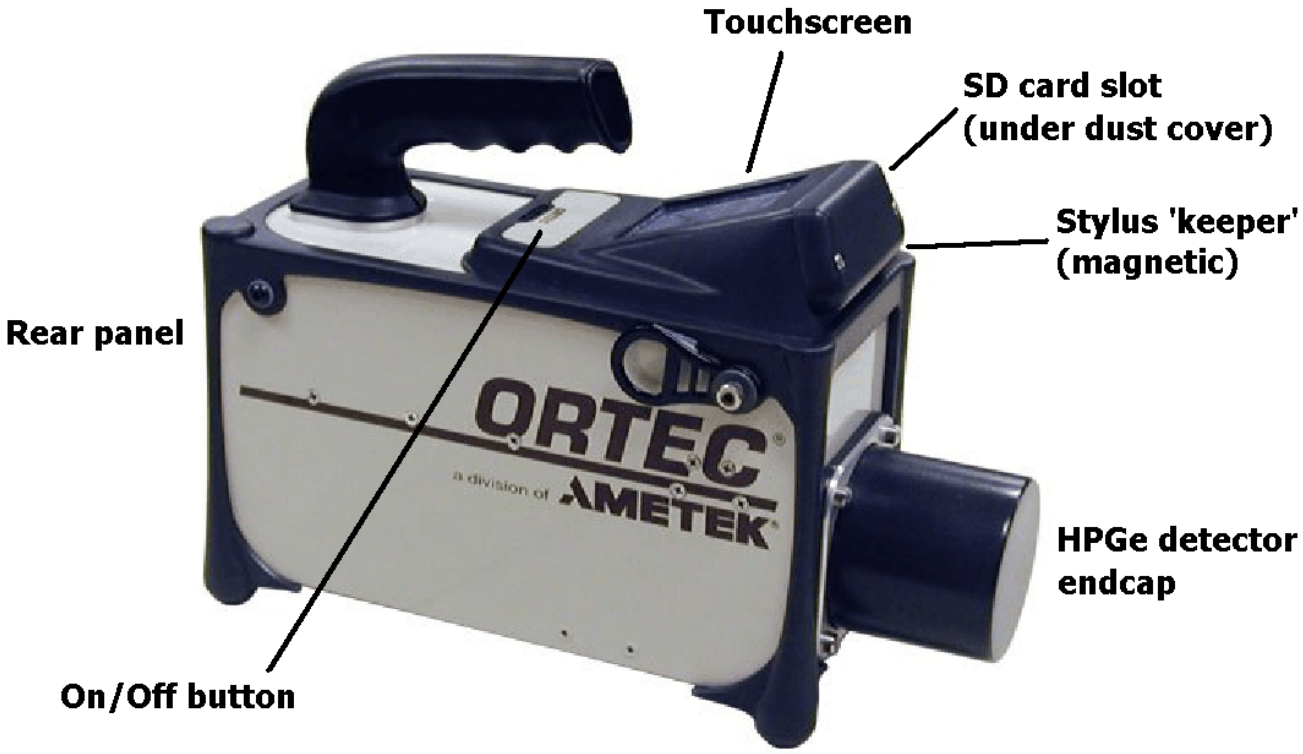

Figure 3. Micro-Detective Features.

2.2.2. Rear-Panel Connectors

- **INPUT POWER** — Supplies external power for operating the Micro-Detective and recharging the internal battery.

- **USB** port ( ) — Used to connect the Micro-Detective's microprocessor to a computer to retrieve stored spectra with the **Data (ActiveSync)** option; and to connect to the Micro-Detective's MCA board with the **Control (MCA Mode)** option.

- Headphone jack ( ) — For audio dose and count-rate warning signals. The speaker volume can be adjusted as described in Section 5.2.8.

Each connector includes a dust cover. *Keep them closed when using the instrument outdoors or where moisture or particulates might contaminate the connectors.*

2.2.3. The Internal Battery

When the internal battery no longer holds a charge (typically, after 3–5 years), contact ORTEC for the appropriate battery replacement kit. See Chapter 10 for instructions on replacing it. Note that the battery hatch is the only part of the Detective case that can be opened without voiding the warranty.

2.2.4. The Touchscreen

The Detective's high-resolution color touchscreen makes it easy to view data acquisition and settings (Fig. 4), as well as change the instrument settings.

To select a function, tap it with your finger or the stylus. When an alphanumeric input is needed, a soft keyboard is displayed at the bottom of the screen (see Fig. 50 on page 51).

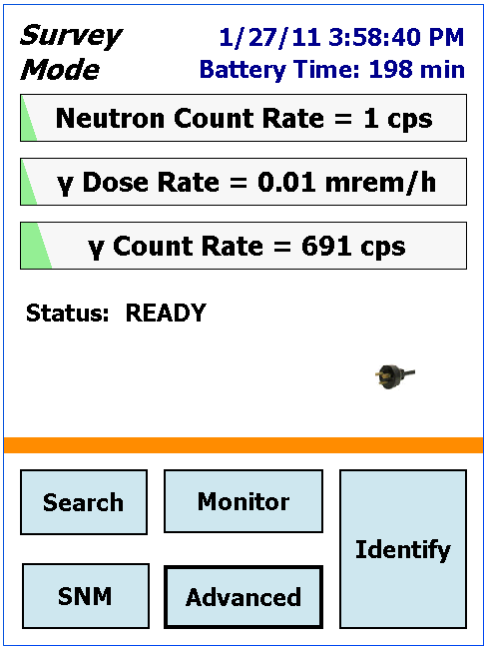

Figure 4. The User Interface.

2.2.5. Attaching the Carrying Strap

The carrying strap (Fig. 5) should be installed on the top-diagonal corners of the Micro-Detective; that is, looking down on the display panel, the strap should be anchored to the left-front and right-rear corners or vice versa. If you wish to change the factory orientation, use a 5/32-in. hex wrench to exchange positions of the strap-hanger studs and the regular hex-head screws. Thread the strap-hanger stud through the hanger bracket, followed by the two spacers, then insert the stud into the Micro-Detective and tighten until the hanger bracket resists rotation but still turns (*do not overtighten*).

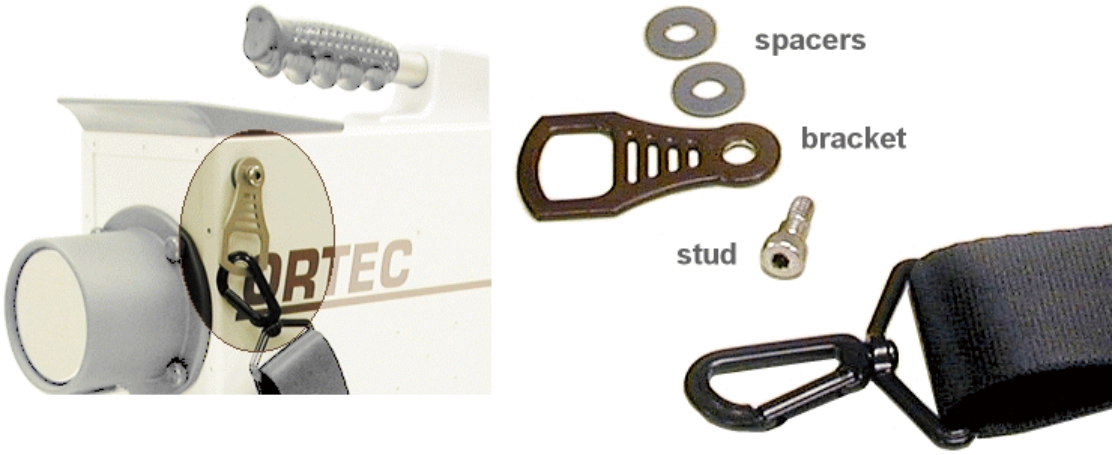

Figure 5. Carrying Strap Attachment.

2.3. The Detective-200

Figure 6 shows the Detective-200's major features. Its front- and rear-panel features are identical to the Micro-Detective's, with the following exceptions: and it uses the same internal battery.

- It has no headphone jack or audio capability.
- The waterproof INPUT POWER connector is position-keyed and secured with a screw collet. When not connected to external power, seal the connector with its threaded, waterproof cap.
- The USB port has a waterproof threaded cap that should be left in place when the port is not in use.

WARNING

At 21.3 kg (47 lbs) the Detective-200 is rated by OSHA as a two-person lift. In addition, it is significantly ***nose-heavy***. Keep this in mind when lifting and positioning the unit.

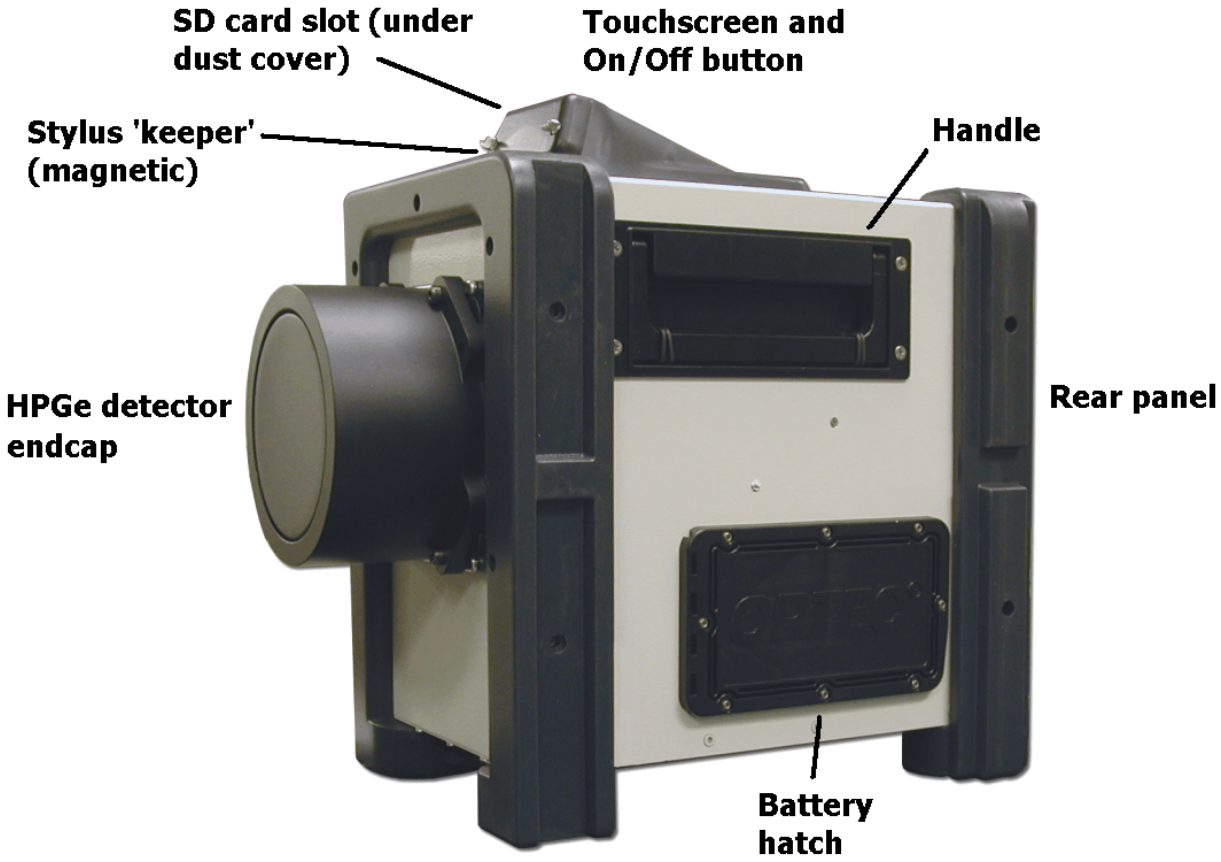

Figure 6. Detective-200 Features.

2.4. Internal vs. External Power

The Micro-Detective and Detective-200 use power in these ways:

- The internal battery provides >3 hours of operation for the Micro-Detective and >2 hours of operation for the Detective-200. The internal battery can start the cooler, however, it cannot completely cool the detector from room temperature; *external power is required*. The transition from internal to external power is automatic and does not interfere with data collection. When recharging an exhausted internal battery, keep in mind that the battery does not begin charging until *after the detector is cooled down to operating temperature* (cooldown nominally takes <12 hours for the Micro-Detective and <24 hours for the Detective-200). At that point, fully recharging the battery takes 3–4 hours.

- The power adapter provides external power to simultaneously start and operate the Detective, as well as charge the internal battery.

- Other external power (supplied by external battery belt or 12 V automobile battery) can start, cool, and operate the Detective, as well as charge the internal battery. When connected to an external battery, the Detective relies on external power until the external voltage drops below 9 V. It then switches to the internal battery. The instrument makes the transition smoothly, and there is no effect on the energy resolution. If you begin with both batteries fully charged, the sum of the two battery capacities will be achieved. If the external battery has its own charge indicator, this can be used to determine when the changeover will occur. The Detective battery monitor indicates the available capacity in the internal battery, and when the switchover occurs, this indicator runs down in the usual manner.

The icon on the lower right corner of the Survey Mode screen's Status area shows whether the Detective is operating on a fully charged battery, a charging battery, or external power. The three respective icons are shown in Fig. 10.

NOTE When all power is exhausted, the high voltage and cooler shut down and the detector begins to warm. The Detective cannot be used again until the unit has cooled enough that the high voltage automatically switches on and the Status indicator changes back to READY.

2.5. Operating Cautions and Notes

- Remember that there are no user-serviceable parts inside the Detective. Opening the Detective (except the battery hatch to replace the internal battery) voids the warranty.

- The cooler and detector are shock-sensitive, with a maximum tolerance of 20 g, so be careful not to drop the unit. A shock in excess of this value will void the warranty.

- The Detective's enclosure is sealed with polymer o-rings and gaskets; if all seals are in place, the instrument can survive *brief* immersion in water. However, care should generally be taken to protect it from prolonged or heavy rainfall and from immersion. Heat is dissipated from the cooler via the Detective baseplate; therefore, do not place the unit in mud, loose soil or sand, standing water, dense grass; or on thick carpet. Wrap or cover the unit to keep it clean and dry. Where possible, avoid placing it on warm surfaces, such as sun-heated pavement, for extended periods. The front-panel memory card slots and rear panel connectors include dust caps; *keep the card slots and all unused connectors capped.*

- The power adapter/charger should not be exposed to water. When in use, it should ideally be placed on a dry, flat, dust-free surface. When not in use, it should be disconnected from the ac power supply and covered to protect it from moisture and dirt. Any covering must be completely removed before reconnecting the power adapter to the input power source. Make sure the recharging connector on both the Detective and power adapter are clean and dry before connecting to an the input power supply.

- Both instruments are designed for use at temperatures between –10°C to +40°C, at a relative humidity <90% at 35°C, non-condensing.

- The HPGe detector assembly is designed to be continuously cooled. If the instrument is turned off and allowed to warm between uses, it must be cooled and brought to operational status (Status: Ready) for *at least 48 hours every month*. Failure to do this may result in degraded performance or cooling system failure. Read Section 9.5.

- To avoid damaging the cooler (and, where applicable, to comply with transportation regulations), be sure the cooler is turned off before shipping the Detective (see Section 2.6.2). The unit can be shipped as soon as the cooler is turned off; there is no need to wait until the detector warms up.

- For best results, we recommend that you not allow the instrument's internal battery to become exhausted, and that you read Section 2.4 on the Detective's internal and external power sources.

- When monitoring very high-activity sources (whether the source is an innocent or threat nuclide), if the detector **Dead Time** exceeds 70%, the detector cannot process gamma radiation and generate IDs according to its performance specifications. A red indicator in the upper right corner of the screen tells you to MOVE BACK from the source until the

dead time drops below 70% so that the instrument can perform as specified. See Fig. 9 (page 17).

- When the most recent background reading is no longer valid, the Background Invalid message is displayed on the Survey Mode screen. The Identify and Monitor buttons become inactive and the system will not post radionuclide IDs until a new background is accepted (see Section 2.10). However, the gamma and neutron count-rate meters on the Survey, Search, and SNM Mode screens continue to function normally, so the unit is still passively monitoring.

2.6. Startup and Cooldown

2.6.1. Connecting the Detective to External Power and Turning It On

- Remove the Detective from its shipping carton.

- Connect the power adapter/charger to an ac power source and to the Detective's rear-panel INPUT POWER connector. Alternatively, you can use the 12 V dc auto accessory adapter. If using a vehicle battery as a power source, note that cooling the detector to operating temperature can significantly discharge the vehicle battery.

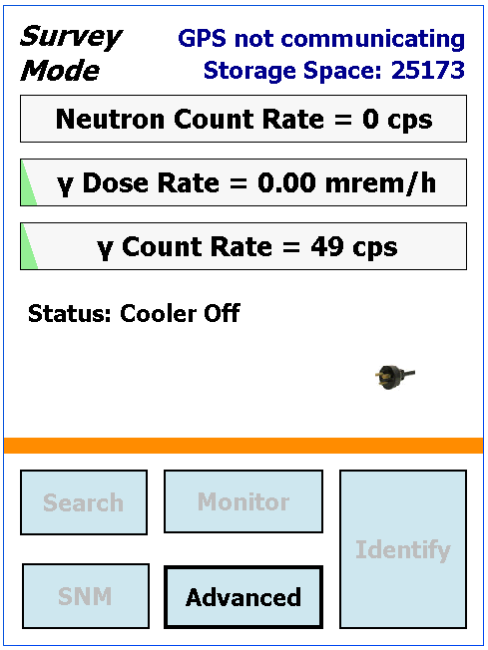

Figure 7. The Display at Startup.

- Press the Detective computer's On/Off button, which is below and right of the touchscreen. The computer will boot up (this can take 1 minute or more), then the Detective program will start up at the Survey Mode ("home") screen. Note that when the program starts, it will take several seconds to initialize and become responsive to button presses. Until the unit is fully initialized, the storage capacity readout and other indicators will not display accurate values.

  (If the Detective program does not start automatically, you will instead see the Microsoft® Windows® Mobile desktop. In this case, start the application by going to the upper left of the screen and tapping **Start**, then **Detective**. It will initialize at the Survey Mode screen.)

- Note the **Status** indicator on the display. On startup it will read Status: Cooler Off as shown in (Fig. 7).

2.6.2. Turning On the Mechanical Cooler

To turn the cooler on:

- Tap the **Advanced** button to display the first Advanced Setup menu page (see Fig. 32, page 41), and tap **Turn Cooler ON**. Within a few seconds, the cooler will activate. You will most likely be able to hear and/or feel the Micro-Detective's cooler. Typically, the cooler is somewhat noisy for the first few minutes of operation, then settles into a quiet hum. You may not be able to hear or feel the Detective-200's cooler. The status indicator will read Status: Cooling.

- If you wish to view the detector and hardware status, tap **Advanced**, **Status** (Section 5.1.1). Until the detector has cooled and the HV has automatically turned on, **Detector Temp**, **Cold Tip Temp**, and **HV Volt** will read ERR, then they will switch to OK.

- A warm Micro-Detective typically requires <12 hours to cool to operating temperature, the Detective-200 typically <24 hours. When the detector reaches operating temperature, the bias voltage will automatically turn on and the status indicator on the Survey Mode screen will read Status: Background is invalid.[7]

- As noted earlier, the internal battery will not charge until the detector has reached operating temperature. After that, the battery will typically reaches full charge in 3–4 hours.

NOTE Once the Detective is cooled, you can turn the cooler off for a brief period (e.g., 10 to 20 minutes) without significantly warming the detector. As soon as the cooler is restarted (assuming the instrument has a valid calibration and background), the unit typically returns to Ready status within a few seconds. The cooler can be restarted at any time without harming the detector crystal, regardless of whether the detector is warm, partially cooled, or cooled to operating temperature.

While the Detective cools, we recommend that you familiarize yourself with the user interface and configure the instrument's software settings.

[7]Until you perform the initial calibration and background (Sections 2.9 and 2.10), the Identify and Monitor modes are disabled; however, the gamma and neutron count-rate meters function as passive monitors.

2.7. The User Interface

2.7.1. Instrument Status Indicators

- **Date/Time, GPS Location, Dead Time, Battery Status, and Storage Space** — The top line in the upper right corner alternates between the date/time, latitude/longitude, and detector dead time. The lower line switches between from the battery status (charging vs. time to full discharge) and the number of spectra that can be stored in the currently selected storage location. See Fig. 8.

- When close to "hot" gamma-ray sources, the HPGe detector can become so busy processing radiation pulses that its analysis algorithm does not function as designed and specified. To avoid this problem, when the detector *dead* (busy) *time* exceeds 70%, a red **Move Back** message is displayed in the upper right corner of the screen (Fig. 9), and persists until you move away from the hot source.

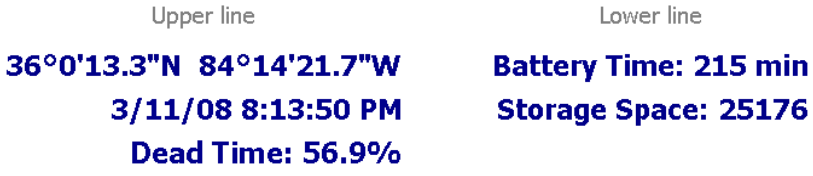

Figure 8. Alternating Status Indicator Displays.

Figure 9. Too Close to High-Activity Source.

- **Instrument Status Area** — The center of the Survey Mode screen provides brief indicator's of the unit's readiness for data acquisition. The Status is either READY (Fig. 17) or Cooling. In addition, warnings such as the high gamma dose rate message are posted in this part of the screen.

- **Power Source Indicator** — The icon in the lower right corner of the Status area shows whether the Detective is operating on a fully charged battery, a charging battery, or external power with a fully discharged battery. The three respective icons are shown in Fig. 10.

Figure 10. Battery Charged; Battery Charging; Battery Discharged (running on external power).

2.7.2. Moving Through the Menus

To move through the dialogs, tap the soft buttons shown on the display. The functions available are shown on the buttons. If a function you want is not shown, it is not available from this dialog. In some cases the function has been disabled in the Advanced Setup.

- To select a function on a dialog, tap the button.

- To return to the preceding dialog, tap **Back**. For example, tapping **Back** from the Advanced Setup dialog (Fig. 11 on page 20) returns you to the Survey Mode screen (Fig. 17).

- On any entry, if you just tap **Back** without tapping any other keys, the current value will be used; that is, no change will be made. Therefore, if you open a dialog by mistake, you can just tap **Back** to return to the previous screen without changing any values.

- If a text or number entry is needed, a soft keyboard will be displayed at the bottom of the screen. Tap the letters or numbers desired and then tap **OK**.

- The Identification, Display, and Search screens have a **Save** button. In Identification Mode and its accompanying Display Mode, this saves the current energy histogram (spectrum) and any identification results. In Search Mode, a histogram of counts vs time is saved. The storage location and file format(s) are selected on the **Spectra** screen (Section 5.3.3). The Spectra screen also includes an **Ask for Sample Description** option that lets you save a text description/comment with Identification Mode spectra.

2.8. Customizing the Detective Settings

In addition to cooling and calibrating the Detective, there are a number of software parameters to be configured.

- **Data storage location and spectrum file format(s)** — See Sections 5.3.3.3 and 5.3.3.4 (page 61). We recommend that spectrum files be stored on SD card, rather than on the Detective computer.

- **Identify Mode settings** — Section 5.2.3 (page 54) tells how to select the ID Display mode (**ANSI** vs. **Classify**), enter an optional real-time count preset, and configure this mode's other display and analysis features. Section 3.2 (page 25) discusses Identify Mode in detail, and provides guidance on the settings.

- **Dose-rate units and alarm thresholds** — Section 5.2.7 (page 59) discusses the default gamma and neutron count-rate alarm thresholds; you may set lower thresholds if you wish. You can also set the displayed gamma dose-rate units to mrem/hr or μSv/hr.

- **Password-restrict Advanced settings and/or the spectrum display (optional)** — The Settings screen (Section 5.2.4.1, page 56) lets you password-lock the second and third Advanced menu screens to minimize unintended settings changes. It also lets you block

users without password access from viewing Identify Mode spectra and stored .SPC spectra.

- **Optional Auto-Calibration** — This feature lets you schedule automatic calibration of an instrument that is connected to external power and in proximity to an appropriate calibration source. See Section 5.2.1 (page 51).

- **Search Mode setup** — The horizontal axis in this mode can be adjusted. See the Search Mode discussion in Section 3.3.

- **SNM Mode setup** — Adjust the dwell time and SNM nuclide detection thresholds for this mode. See the discussion in Section 3.5.

2.9. Checking the Calibration

Once the Detective has cooled and the Background is invalid status is displayed, the next setup step is to check the calibration. This procedure checks and adjusts the Detective's electronics so that it correctly identifies the nuclides in the area. For an application as important as interdiction of illicit nuclear materials trafficking, it is important to know that the nuclide identification is correct. Routine use of the recalibration feature is a solid means of quality assurance, which can be used to support legal proceedings. The digital electronics are extremely stable, and in most situations are unlikely to need recalibration except at long intervals: days or weeks. However, if wide ranges of ambient temperature variation are experienced (say, a change of 20°C), we recommend checking the calibration more often.

NOTE Before using the **Calibrate** feature, the calibration source must be selected on the **Cal. Settings** dialog under the Advanced Settings. The Detective lets you choose from two predefined calibration sources, ^{137}Cs or ^{40}K; or define one or two of your own sources. See Sections 5.2.1 and 5.1.3.

A small calibration source can be used in conjunction with the manual calibration check to ensure the unit remains in calibration.

To perform the manual calibration check:

- On the Survey Mode screen, tap **Advanced** (see Fig. 11), then **Calibrate**.

- Position the indicated source (in our example, a user has defined and selected a ^{60}Co source) in front of the detector window, then tap the **Start Calibration Now** (Fig. 12) button.

- While calibration is in progress (Fig. 13), a **Time remaining** readout should be displayed. This interval will depend on the strength and proximity of your calibration source.

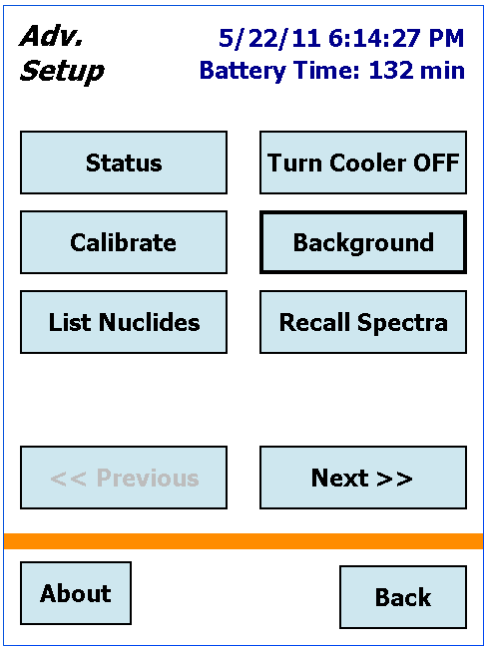

Figure 11. On the Advanced Menu, Tap the Calibrate Button.

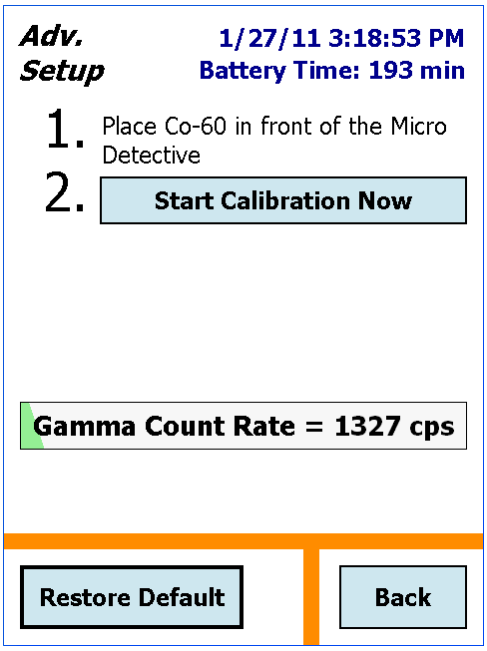

Figure 12. Tap the "Start Calibration Now" Button.

NOTE If the **Time remaining** readout is not displayed, the calibration source is too weak or too far from the detector to complete the calibration; or you may be using the wrong source. Tap **Abort Calibration**, correct the situation, and restart the calibration. See also the troubleshooting steps in Section 7.7 (page 71).

- At the end of the calibration period, the **Use Improved Calibration** button will be displayed, along with the calibration and peak-shape indicators for the new measurement (Fig. 14). The choice is yours whether to use this new calibration or not. To accept it, tap **Use Improved Calibration**. Usually, the proposed change in calibration is of the order of the one shown in Fig. 14. If it is larger than 0.3%, the cause should be investigated (see Section 7.6).

- The final step is to take a representative background measurement. Figure 15 shows the final calibration screen. Remove the calibration source, tap the **Run a Background** button, then refer to Section 2.10 below.

NOTE A new background measurement is *required* after calibration. If you tap **Back** without accepting the new background, only the gamma and neutron count-rate meters will function; Identify and Monitor Modes will be disabled until another you run and accept a new background.

For additional information on calibration and calibration setup, see Sections 5.2.1 and 5.1.3.

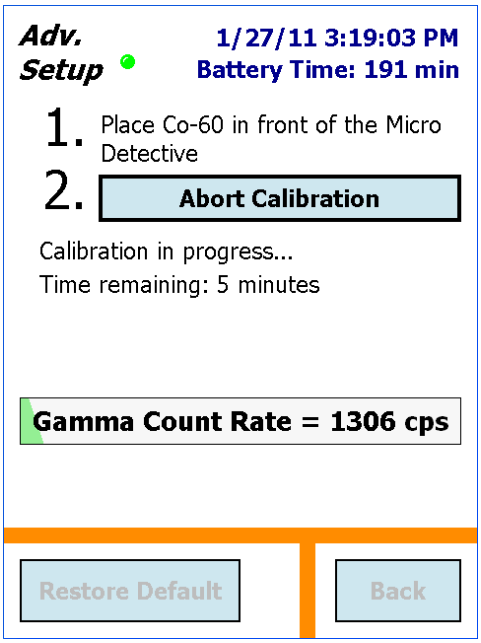

Figure 13. Status of Manual Calibration.

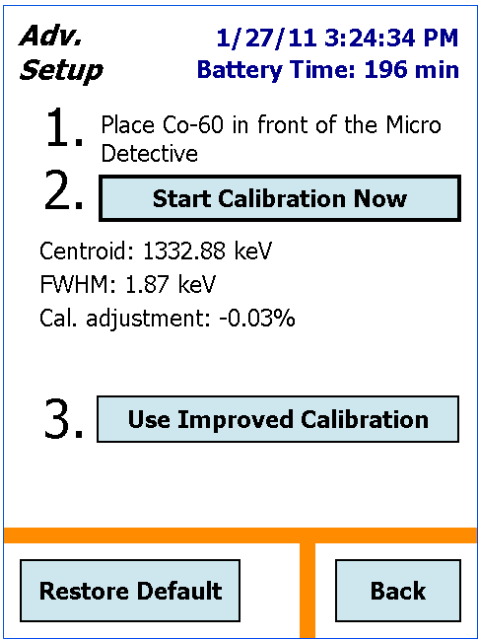

Figure 14. Apply New Calibration Selection.

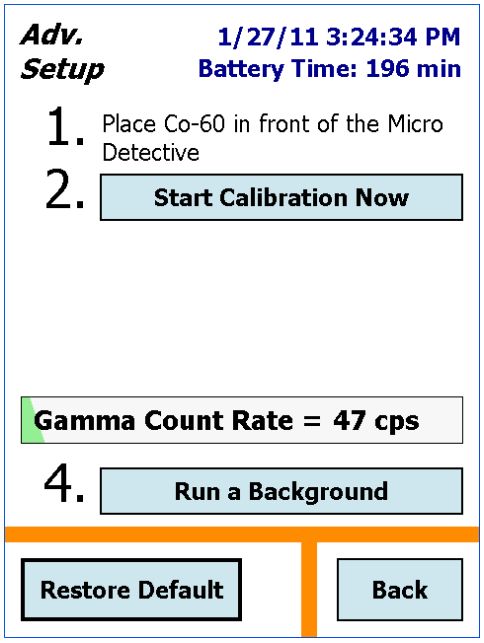

Figure 15. A New Background Is Required.

2.10. Running A New Background After Calibration

The manual calibration routine deletes the current background.chn file. Therefore, the final step of manual calibration is to run a new background.

NOTE *This section discusses only the mandatory background measurement required to complete the manual calibration.* For the full discussion of Detective background measurements, see Section 5.2.2. As noted elsewhere, until you complete the background measurement, the Identify and Monitor Modes are disabled.

The minimum acceptable data collection time for the background meas is set on the **Bkg Settings** screen (see Fig. 55, page 54). Note that, for optimum counting statistics, we recommend a minimum 30-minute background acquisition. However, the background settings screen also allows minimum intervals of 1, 5, or 15 minutes.

- All sources should be removed from the area before you tap the **Run a Background** button at the end of the manual calibration routine. If you leave the source in place, a "high count rate" message will remind you to remove the source and restart the calibration.

- Tapping the **Run a Background** button opens the screen shown in Fig. 16 and automatically starts the background acquisition.

- Acquisition continues until you tap either **Save** or **Cancel**, which returns you to the **Advanced** menu. *If the measurement is canceled before the minimum time has elapsed, the software does not accept (i.e., save and use) the new background spectrum.*

  (If necessary, you can obtain a valid background later; however, the background must be performed before the unit is ready for field use. See the instructions in Section 5.2.2.)

- When you return to the Survey Mode screen, the status will now indicate Ready.

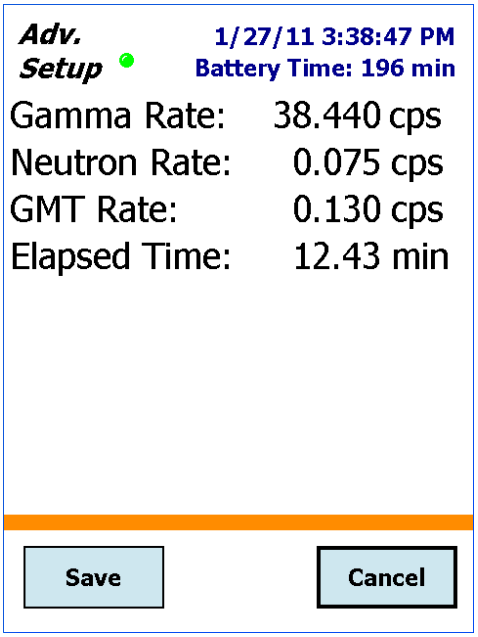

Figure 16. Collect Background for At Least the Specified Minimum Time.

****** The Detective is now ready to use ******

3. RADIATION MONITORING

Once the Detective displays the Ready status, the calibration has been checked, and the background has been measured, the instrument is ready for use. This chapter tells you how to use the Survey, Identification, Search, Monitor, and SNM Modes.

> *Some users will find enough information in this chapter to begin using the Detective right away — operation is very straightforward.*

However, we also recommend the following reading:

- Chapter 4 lists the messages the Detective displays when it identifies radionuclides.

- Chapter 5 discusses the functions on the **Advanced** menu. These administrator-level commands allow you to set up and adjust a number of detector functions, such as turning on the mechanical cooler, selecting the location where spectrum files will be stored, choosing the dose-rate units to be displayed, determining the frequency of auto-calibration, configuring the SNM search dwell time and quality factor, customizing the dose alarm sensitivity, and adjusting the "scroll rate" for the Search Mode strip-chart emulation.

  IMPORTANT You can set a password to limit access to the second and third pages of the **Advanced** menu; see Section 5.2.4.1 for instructions.

- Chapter 6 provides instructions on downloading spectrum files to a computer.

- Chapter 8 gives detailed information on connecting the Detective to a computer and using it as a high-performance benchtop multichannel buffer (MCB) with MAESTRO or other ORTEC spectroscopy applications.

3.1. Survey (Count-Rate/Dose-Rate) Mode

In Survey Mode (Fig. 17), the Detective behaves as a passive monitor, showing the current gamma count and dose rate; neutron count rate (for units so equipped); instrument status; detector dead time, available disk storage space and battery charge; time and date; and GPS coordinates.

The three rate indicators show the count rate or dose as both a value and a bar graph. The color of the bar changes with increasing rate. The lowest rate is green, then yellow, then red. The γ (gamma) **Count Rate** bar changes to yellow at~6300 counts per second (cps), and red at ~13300 cps. At ~20,000 cps, the red bar begins flashing. These various states are illustrated in

Fig. 18. The factory-set alarm limits are 10000 μSv/h for the **Gamma Dose Rate** and 500 cps for the Neutron Count Rate bar. To set lower limits, see Section 5.2.7.

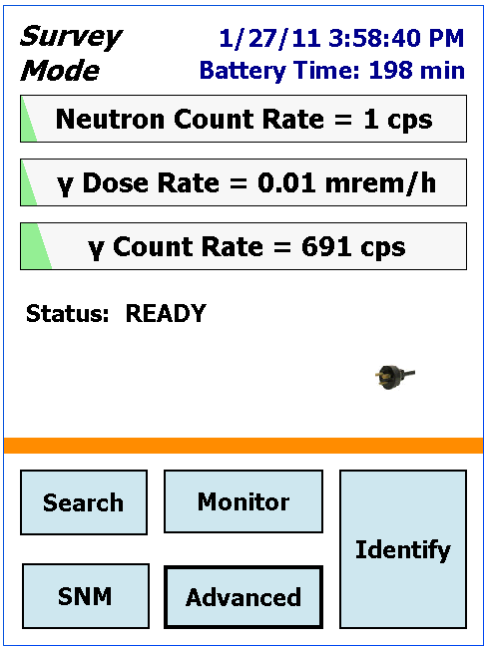

Figure 17. The Survey Mode Screen.

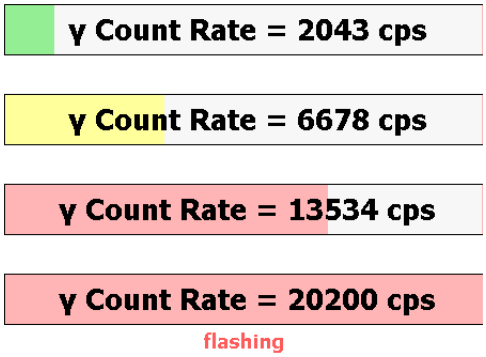

Figure 18. The Gamma Count-Rate Meter As Count Rate Increases.

When the gamma dose rate goes above the limit, the WARNING!!! High Gamma Dose Rate! message is displayed in the Instrument Status Area and an alarm sounds. You can optionally choose to set lower gamma dose rate and neutron count rate alarms using the Dose Alarm setup feature under the Advanced Settings screen (Section 5.2.7).

- Tap **Identify** to start the Identification Mode Section 3.2).
- Tap **Monitor** to start the Monitor Mode (Section 3.4).
- Tap **Search** to start the Search Mode (Section 3.3).
- Tap **SNM** to use the SNM Mode (Section 3.5).
- Tap **Advanced** to display the Advanced Setup dialog (Chapter 5).

NOTE If a blue simulated LED (●) is displayed in the upper left, beside the screen title, the instrument is in the LCX radiation detection mode, which we strongly recommend for use only by experienced gamma spectroscopists. Be sure to read Section 5.2.3.3 and/or refer to your organization's operating procedures before using LCX Mode.

3.2. Identification Mode

The Identification Mode lists the radionuclides present; and displays them in one of two ways, according to the ID Display Mode selected on the **Identify** setup screen (Section 5.2.3.2).[8] There are two ID Display Modes:

- **"ANSI" Mode** — This is the default mode. Radionuclide IDs are listed on a background color-coded according to their status as innocent (green), suspect (yellow; LCX Mode only), or threat (red). The color background can be suppressed (Section 5.2.3.4).

- **"Classify" Mode** — In this mode, the list of detected radionuclides are listed according to category instead of radionuclide name, e.g., **Medical**, **Industrial**, **Nuclear Plutonium**, **Other**.

Figures 19 and 20 compare the same three IDs as displayed in the "ANSI" and "Classify" modes, respectively. In each figure, the Detective has found one industrial nuclide (unshielded ^{241}Am; innocent), and two uranium isotopes (^{235}U and ^{238}U; threats).

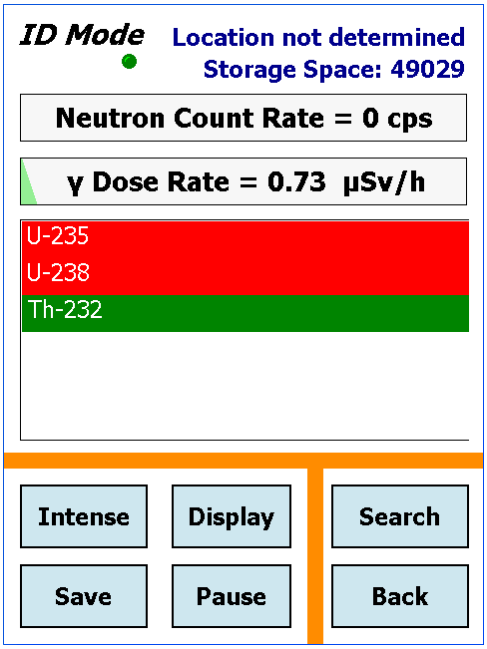

Figure 19. Identification Mode Screen in "ANSI" ID Display Mode.

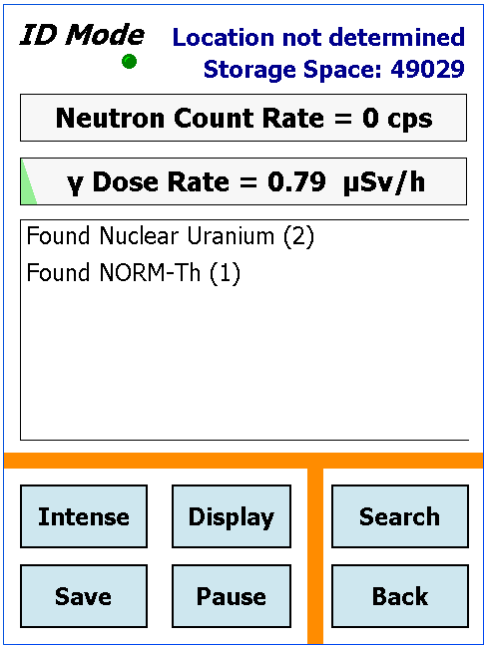

Figure 20. Identification Mode Screen in "Classify" ID Display Mode.

[8]The expert LCX Mode (Section 5.2.3.3) also displays *suspected* IDs, i.e., nuclides that have been tentatively identified at too low a confidence level to list them as definitively "found."

Chapter 4 lists all nuclide IDs along with "ANSI" their threat/suspect/innocent status and "Classify" category.

In addition, this screen allows you to:

- **Pause/Continue** the current identification measurement. This button has additional functions if you are counting to a real-time preset (see Section 3.2.2).
- **Save** the current spectrum and IDs (Section 3.2.3).
- On the "Classify" display, tap to display found-nuclide reports (Section 3.2.4).
- Tap **Intense** to display a continuously updating list of the 10 highest-confidence peaks currently being detected (Section 3.2.5).
- **Display** the real-time spectrum for the current data acquisition (Section 3.2.6) (unless the spectrum view has been disabled on the Settings dialog [Section 5.2.4.2], in which case there will be no Display button on the screen).
- Switch to **Search** mode (Section 3.3). *If you do not **Save** the current spectrum and identification results before going to Search Mode, these data will be lost.*

3.2.1. Start the Identification

To start an identification, tap the **Identify** button on any screen that displays it.

NOTE When you start an identification, the Search, Monitor, or SNM data in the spectrum memory are *erased* before the identification data are collected.

During data acquisition, a simulated green LED flashes at the top left of the screen. On units with GPS capability, the top right of the screen alternates between the elapsed acquisition time for the current spectrum and the GPS coordinates.[9] In addition, the neutron count rate and the gamma dose rate continually update.

At any time you can **Pause** the count and either **Save** the spectrum, return to the Survey Mode screen, or **Continue** counting. (You can save at any time during an identification, and as many times as you wish. The name of each saved spectrum file will include the time at which it was saved.)

[9]If your GPS has not received signals from GPS satellites for >30 days (e.g., if it has not been in use or has been used continuously indoors), it may take 10–15 minutes for the unit to update and begin displaying location information.

If counting to a **Real Time Preset**, the elapsed time readout counts from zero to the preset (Fig. 21). Once the preset time has elapsed, the **Pause** button changes to **Continue**. At this point, you can either **Save** the spectrum or *extend the count* to add more data to the spectrum, as described in the next section.

Figure 21.

3.2.2. Extending the Count-to-Preset

To extend the count after the first preset count interval has lapsed — that is, to collect more data for this measurement — just tap the **Continue** button. The extended count will start, and the **Continue** button label will change back to **Pause**. Acquisition will resume, and will continue until you stop it by tapping **Back** (or by pausing again). The **Elapsed Time** readout at the top right of the screen will track the total count time.

NOTE Tapping **Pause** or **Continue** *does not clear the spectrum*. Pausing simply suspends data collection. When you continue, subsequent data are added to the existing spectrum until you tap **Back** to return to the Survey Mode screen. (Returning to Survey Mode clears all spectrum and analysis data.)

3.2.3. Save

Tap **Save** to write the current identification spectrum and results in the selected data storage location and file formats (Sections 5.3.3.3 and 5.3.3.4, respectively). You may save as many times as you wish, during acquisition or pauses. The name of each saved spectrum file will include the time at which it was saved.

The results are saved in the spectrum file(s) and can be viewed both on the Detective (Section 5.1.6) and with ORTEC spectroscopy applications such as MAESTRO. An identifying text description can also be entered if the **Ask for Sample Description** feature is enabled on the Spectra dialog (Fig. 68, page 60).

To end without creating a spectrum file, tap **Back**. This immediately returns you to the Survey Mode.

3.2.4. View Found Nuclides List for Classify ID Display Mode

Because the Classify ID Display Mode lists categories instead of specific radioisotope names, the Detective provides a screen that lists the **Found Nuclides** (and **Suspect Nuclides** in LCX Mode). To view the found nuclides, simply tap any of the ID messages on the ID Mode screen. The first tap will open the **Found Nuclides** report (see Fig. 22). Each ID will have a red, yellow, or green background corresponding to its threat level as described in Chapter 4. To access the Suspect Nuclides report in LCX Mode, tap an ID message on the Found screen. The report

screens let you **Save** the current spectrum and identification results to disk and **Display** the current spectrum. Tap **Back** to return to the main Identification Mode screen.

3.2.5. Intense (View Highest-Intensity Spectrum Lines)

Tap **Intense** to view the list of most intense gamma-ray lines in the spectrum. The most intense lines list is a continuously updating list of the 10 best peaks currently detected (Fig. 23).

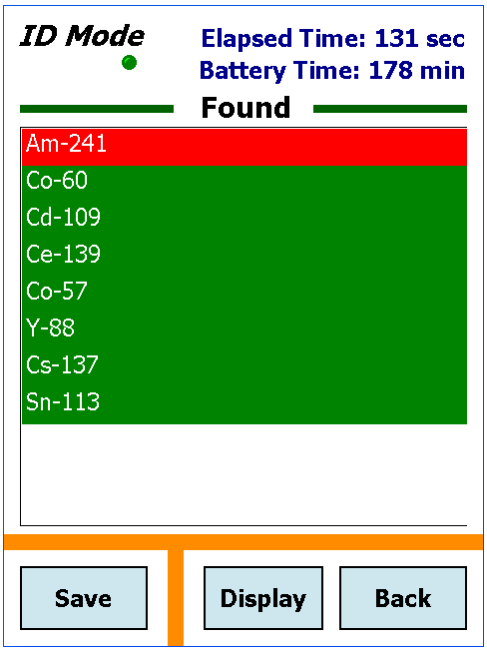

Figure 22. View Found Nuclides List.

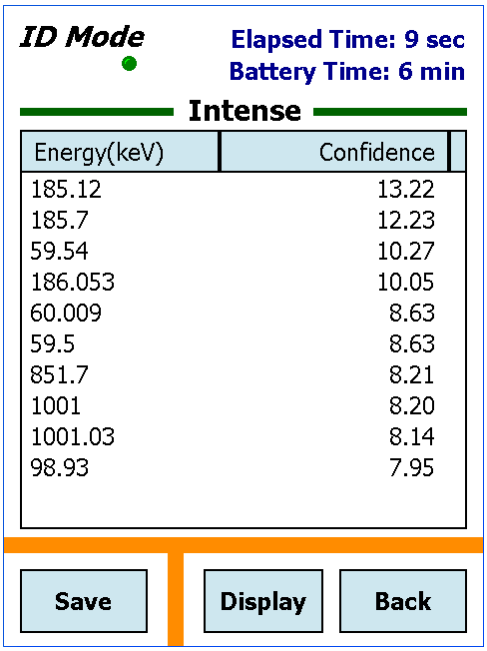

Figure 23. View Top Lines.

The energies are based on the internal nuclide library. The rank is based on the confidence value for the peak. When a detected energy matches an entry in the library, its tentative identity is posted on this screen, by peak energy, in column 1; and ID confidence factor (also called the *Q* value), in column 2. The higher the confidence value, the more likely that the peak is a real gamma ray peak and not background noise. It should be understood, however, that a peak could be seen in the top lines list but the corresponding nuclide not reported as found. This is because there are many other tests applied before an identity or tentative identity is chosen. In general, any **Confidence** value over 25 indicates a good peak.

To return to the Identification Mode tap **Back**.

Tap **Save** to save the current spectrum and identification results in the selected data storage location and file format(s). Tap **Display** to view the current spectrum (see Section 3.2.6).

3.2.6. Display Spectrum

The Display screen (Fig. 24) plots the gamma-ray energy spectrum currently in memory. This feature gives the expert spectroscopist more information about the nuclides present. The expert can then make more informed decisions about the material under investigation.

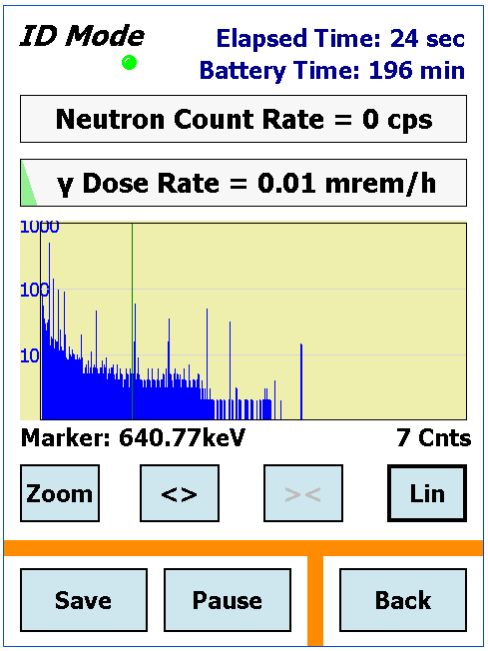

Figure 24. Spectrum Display Mode.

To enter Display Mode, tap the **Display** button. See the **Display Controls** discussion below.

Tap **Save** to save this spectrum and identification results to the selected data storage location and file formats. Tap **Back** to return to the previous dialog.

Because the spectrum display area is limited, a modified version of scientific notation is used when labeling the Y axes for numbers greater than or equal to 10,000: The number of trailing zeros in the number is replaced by "E" followed by the number of zeros. Some examples: 10,000 becomes **1E4**; 12,000 becomes **12E3**.

The spectrum display has a vertical marker line. Its position in the spectrum (in keV) and the counts in the marker channel are displayed immediately below the spectrum. To move the marker to a different location, tap the desired position. The energy and counts-per-channel will update correspondingly. You can also tap and drag the marker left or right to a new location.

3.2.6.1. Display Controls

The spectrum display control buttons are just below the display. You can use them to show the spectrum in different ways for better interpretation of the spectrum.

- **Full/Zoom** — In the expanded view, the **Full** button restores the display to 8000 channels. In the full view, the **Full** button changes to **Zoom** and zooms the display to the last horizontal expansion before **Full**. In this way, you can easily look at the peaks in the spectrum in detail (**Zoom in**) and move quickly from energy to energy in Full mode.

- **Zoom In** <> — The <> button expands the display by halving the number of channels, so the peaks appear wider. The center channel of the new display will be the marker position.

- **Zoom Out** >< — The > < button contracts the display by doubling the number of channels, so the peaks appear narrower. The center channel of the new display will be the marker position or channel 0 is the leftmost corner of the display or channel 8192 is the rightmost corner of the display.

- **Lin/Log** — The **Lin** button changes the vertical display to linear mode and automatic vertical limits. The **Lin** button changes to **Log** in the linear mode. Tap **Log** to change the vertical scale to log mode.

- **Pause/Continue** — If the Detective is acquiring data, you can pause the data collection and resume it later. Tap **Pause** to stop collection. The button will change to **Continue** in the pause mode. Tap **Continue** to resume the data collection.

3.3. Search Mode

The Search Mode screen is a "strip-chart" emulation that displays total count rate (gamma and neutron) vs time (see Fig. 25). The gamma-ray data are presented in blue and the neutron data are shown in red. To adjust the x-axis "dwell time," see Section 5.2.5.

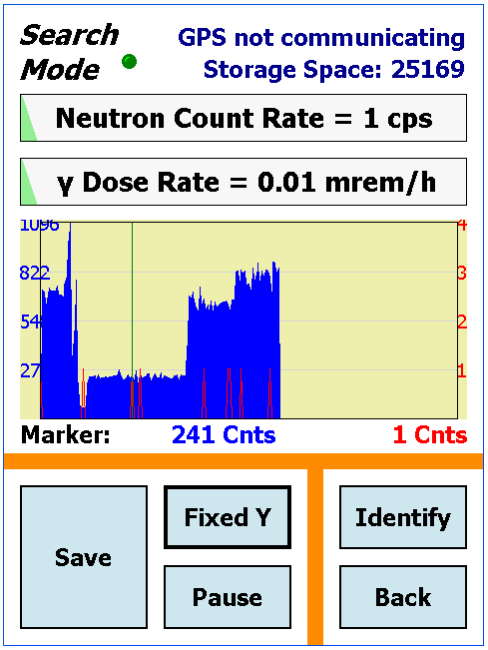

Figure 25. "Strip Chart" Emulation With Autoscaled Y-Axes.

Because the spectrum display area is limited, a modified version of scientific notation is used when labeling the Y axes for numbers greater than or equal to 10,000: The number of trailing zeros in the number is replaced by "E" followed by the number of zeros. Some examples: 10,000 becomes **1E4**; 12,000 becomes **12E3**.0 cps and the neutron data are scaled from 0 to 500 cps.

The Y-axes can be autoscaled (**Scaled Y**) so the current maximum Y value for both counts is near the top of the graph, as shown in Fig. 25; or fixed (**Fixed Y**) such that the gamma-ray data are scaled from 0 to 1000.

- From the Survey Mode screen, tap **Search**. The search will continue until you stop it, but only the most current count rate values (the newest 221) are displayed and can be saved.

- To save the displayed search results, tap **Save**. If the **Ask for Sample Description** option is enabled on the Spectra setup screen (see Fig. 68, page 60), a soft keyboard will open so you can enter a description for this data acquisition; tap **Set** to complete the save. If saving in ORTEC .CHN format, two count-rate "strip chart" files are saved for each

search, one for the gamma count (labeled with a G suffix) and one for the neutron count (with an N suffix). For ANSI .N42 files, one file with both gamma and neutron count rate (with a B suffix) is created. The filenames are automatically generated (Section 1.4.2) and saved according to the spectrum settings (Section 5.3.3).

- To pause a search acquisition, tap **Pause**. The **Pause** button will change to **Continue**, as shown in Fig. 26. Tap **Continue** to resume the search. The display will be continuous, that is, it will not show a gap that spans the paused time.

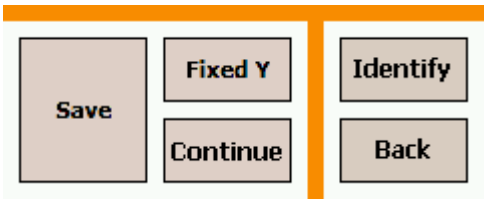

Figure 26. The Search Mode, Paused.

- To go directly to the Identification Mode, tap **Identify**. If you have not already saved the current Search data, they will be lost when you change modes.

- To end this search and return to the Survey Mode (Fig. 17), tap **Back**. (The current search data will be lost.)

3.4. Monitor Mode

Use the Monitor Mode (Fig. 27) to identify radionuclides while moving relative to object(s) of interest. An example application is an *ad hoc* portal monitor where packages or people pass by the instrument. This mode is also useful as a search tool where the instrument is carried by the user in an effort to locate and identify a radioactive source.

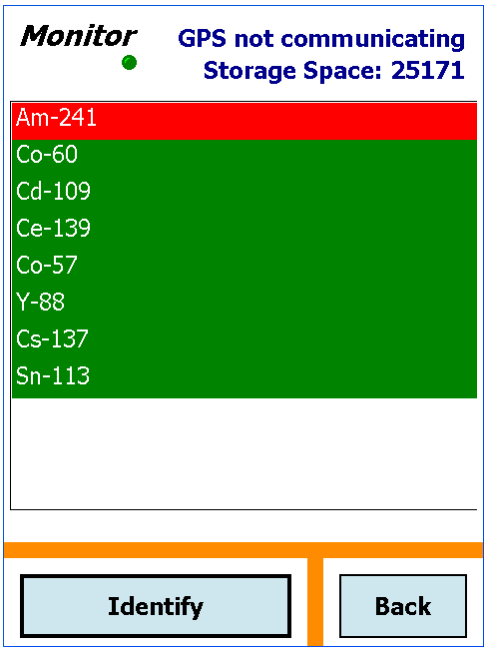

Figure 27. Monitor Mode.

The Detective collects one spectrum per second, and analyzes a rolling window of the eight most recent spectra for radioisotope IDs. This makes it particularly suited to situations where a completely different set of objects may be presented to the instrument in that time interval.

Each ID's background is color-coded according to its threat status (see the ID table in Chapter 4): red for threat nuclides; green for innocent; and, in LCX Mode only, yellow for suspects.

Each ID persists until you tap to acknowledge it — this ensures that no ID goes unnoticed. Once acknowledged, the ID then persists until the source that triggered it is no longer being detected.

Monitor Mode searches cannot be saved. To collect data that can be saved and reviewed later, tap **Identify**.

3.5. SNM Search Mode

The SNM Search Mode screen (Fig. 28) displays bar graphs showing how closely identifications of ^{239}Pu, ^{235}U, and neutron flux approach user-selected detection thresholds. The thresholds are set on the SNM Search Mode setup dialog under Advanced Settings (Section 5.2.6).

Because ^{133}Ba can be used as a plutonium surrogate, advanced users can enable a ^{133}Ba search for training purposes and for developing a site's concept of operations. If the ^{133}Ba search is disabled, its bar graph is not displayed on the SNM search screen.

SNM searches cannot be saved. To collect data that can be saved and reviewed later, tap **Identify**.

Figures 28 through 31 depict a search in which ^{133}Ba is detected. At the start of the search, the status message says **Continue to search** (Fig. 28). This message is displayed until the detection threshold for any one of the radionuclides or neutrons is crossed. As a ^{133}Ba source nears, the confidence bar associated with it begins to lengthen and approach the threshold (Fig. 29).

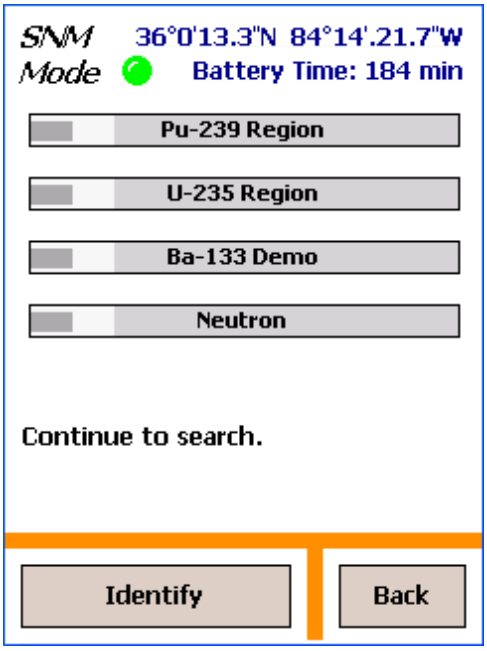

Figure 28. SNM Search Under Way.

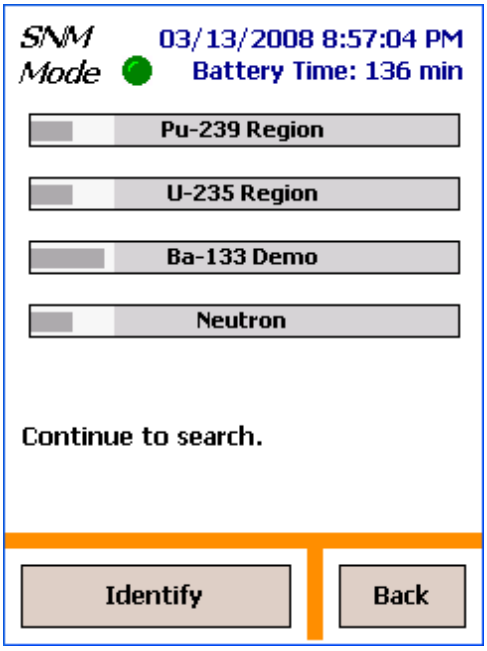

Figure 29. ^{133}Ba Threshold Almost Exceeded.

As the Detective comes close to the ^{133}Ba source, the identification for the radionuclide exceeds the threshold. The confidence bar enters the shaded part of its box, and the shading turns red to indicate the radionuclide has been found (Fig. 30). Figure 31 shows a high-probability hit. To verify the presence of SNM, tap **Identify** to switch to Identification Mode.

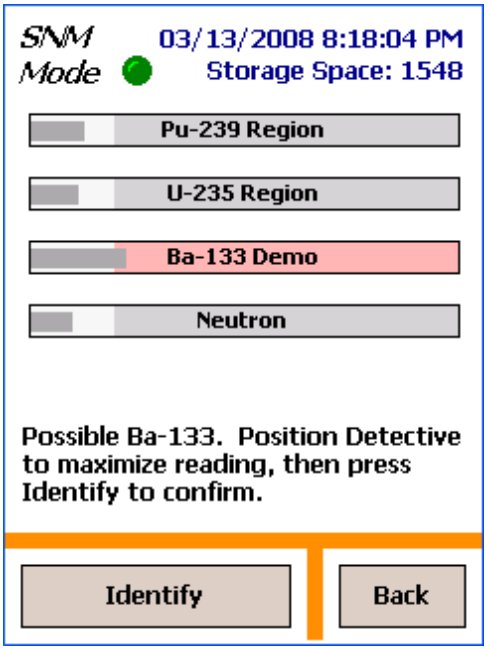

Figure 30. ^{133}Ba Tentatively Detected.

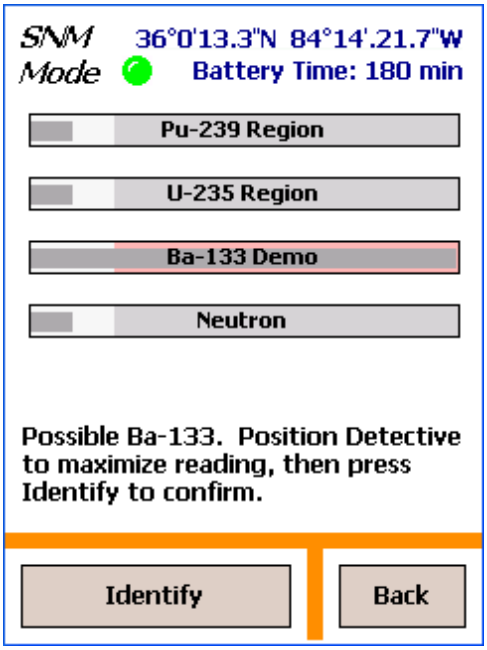

Figure 31. High Confidence That ^{133}Ba Has Been Detected. Use Identification Mode to Verify.

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4. IDENTIFICATION MESSAGES AND RADIONUCLIDE LIBRARY

This chapter provides the list of identifications for the v8.6 nuclide library, and their categorization in the “ANSI” and “Classify” ID Display Modes (Section 5.2.3).

Identification	Category	
	ANSI Mode	Classify Mode
186 keV peak present	Suspect	Nuclear Uranium
2614 keV peak present	Suspect	Nuclear Uranium
375/414 peak present	Suspect	Nuclear Plutonium
Ac-225	Innocent	Medical
Ac-227	Innocent	Industrial
Ag-110m	Innocent	Industrial
Am-241	Threat	Industrial
Am-241 (shielded)	Threat	Nuclear Plutonium
Am-241 (unshielded)	Innocent	Industrial
Ar-41	Innocent	Industrial
As-72	Innocent	Industrial
As-74	Innocent	Medical
At-211	Innocent	Other
Au-198	Innocent	Industrial
Ba-133	Innocent	Industrial
Ba-140	Innocent	Industrial
Be-7	Innocent	Industrial
Beta emitter	Innocent	Bremsstrahlung
Bi-207	Innocent	Other
Bi-212 (Th-232/U-232 daughter)	Innocent	Industrial
Bi-214 (Ra-226 daughter)	Innocent	NORM
Br-76	Innocent	Other
Br-76 (heavily shielded)	Innocent	Other
Br-76 (shielded)	Innocent	Other
Br-77	Innocent	Industrial
Ca-47	Innocent	Industrial
Cd-109	Innocent	Other
Cd-115	Innocent	Industrial
Ce-139	Innocent	Medical
Ce-141	Innocent	Medical
Ce-144	Innocent	Industrial
Cm-242	Innocent	Industrial

Identification	Category	
	ANSI Mode	**Classify Mode**
Cm-243	Innocent	Industrial
Cm-244	Innocent	Industrial
Co-55	Innocent	Industrial
Co-56	Innocent	Other
Co-56 (shielded)	Innocent	Other
Co-57	Innocent	Industrial
Co-57 (shielded)	Innocent	Industrial
Co-58	Innocent	Medical
Co-60	Innocent	Industrial
Cr-51	Innocent	Other
Cs-131	Innocent	Medical
Cs-134	Innocent	Industrial
Cs-137	Innocent	Industrial
Cu-64	Innocent	Other
Cu-67/Ga-67	Innocent	Medical
Enriched Uranium	Threat	Nuclear Uranium
Eu-152	Innocent	Other
Eu-154	Innocent	Other
Eu-155	Innocent	Other
Eu-156	Innocent	Other
F-18	Innocent	Medical
Fe-59	Innocent	Other
Ga-64	Innocent	Other
Ga-64 (shielded)	Innocent	Other
Ga-67	Innocent	Medical
Ga-67 (shielded)	Innocent	Medical
Gd-153	Innocent	Other
Gd-159	Innocent	Other
Ge-68/Ga-68	Innocent	Medical
HEU	Threat	Nuclear Uranium
Hf-181	Innocent	Industrial
Hg-203	Innocent	Industrial
Ho-166	Innocent	Other
Ho-166m	Innocent	Industrial
Ho-166m (shielded)	Innocent	Industrial
I-123	Innocent	Medical

Identification	Category	
	ANSI Mode	Classify Mode
I-123 (shielded)	Innocent	Medical
I-124	Innocent	Medical
I-125	Innocent	Medical
I-126	Innocent	Industrial
I-126 (shielded)	Innocent	Industrial
I-131	Innocent	Medical
I-131 (shielded)	Innocent	Medical
I-132	Innocent	Industrial
I-133	Innocent	Industrial
I-134	Innocent	Industrial
I-135	Innocent	Industrial
In-111	Innocent	Medical
Ir-192	Innocent	Industrial
Ir-192 (shielded)	Innocent	Industrial
Ir-194 (shielded)	Innocent	Other
K-40	Innocent	NORM
Kr-87	Innocent	Industrial
Kr-88	Innocent	Industrial
Kr-88 (shielded)	Innocent	Industrial
La-138	Innocent	NORM
La-140	Innocent	Other
Lu-172	Innocent	Medical
Lu-176	Innocent	NORM
Lu-177	Innocent	Medical
Lu-177m	Innocent	Medical
Mn-52	Innocent	Industrial
Mn-54	Innocent	Other
Mn-56	Innocent	Industrial
Mo-99	Innocent	Medical
Na-22	Innocent	Other
Na-24	Innocent	Medical
Nb-92m	Innocent	Industrial
Nb-94	Innocent	Industrial
Nb-95	Innocent	Industrial
Nb-96	Innocent	Industrial
Nb-96 (shielded)	Innocent	Industrial

Identification	Category	
	ANSI Mode	**Classify Mode**
Nd-147	Innocent	Industrial
Neutrons	Threat	Other
Neutrons CR	Threat	Neutron
Neutrons on Fe	Threat	Other
Neutrons on Hydrogen	Threat	Other
Np-237	Threat	Nuclear Neptunium
Os-194/Ir-194	Innocent	Other
Pa-231	Innocent	Industrial
Pb-203	Innocent	Industrial
Pd-103	Innocent	Medical
Po-210	Innocent	Other
Pr-144	Innocent	Industrial
Pu-238	Threat	Nuclear Plutonium
Pu-239	Threat	Nuclear Plutonium
Ra-223	Innocent	Industrial
Ra-226	Innocent	NORM
Rb-83	Innocent	Medical
Rb-86	Innocent	Medical
Rh-105	Innocent	Industrial
Ru-103	Innocent	Industrial
Ru-106/Rh-106	Innocent	Medical
Ru-97	Innocent	Industrial
Sb-124	Innocent	Industrial
Sb-124 (shielded)	Innocent	Industrial
Sb-125	Innocent	Industrial
Sb-127	Innocent	Industrial
Sc-46	Innocent	Medical
Se-75	Innocent	Medical
Sm-153	Innocent	Medical
Sm-153 (shielded)	Innocent	Medical
Sn-113	Innocent	Other
Sr-82/Rb-82	Innocent	Medical
Sr-85/Kr-85	Innocent	Industrial
Sr-89	Innocent	Medical
Ta-182	Innocent	Other
Tc-96	Innocent	Industrial

Identification	Category	
	ANSI Mode	Classify Mode
Tc-99m	Innocent	Medical
Te-132	Innocent	Industrial
Th-229	Innocent	NORM-Th
Th-230	Innocent	NORM-Th
Th-232	Innocent	NORM-Th
Tl-200	Innocent	Other
Tl-201	Innocent	Medical
Tl-202	Innocent	Other
Tl-204	Innocent	Medical
Tm-170	Innocent	Medical
Tm-171	Innocent	Industrial
U-232	Threat	Nuclear Uranium
U-233	Threat	Nuclear Uranium
U-235	Threat	Nuclear Uranium
U-238	Threat	Nuclear Uranium
Unknown Peak	Threat	Other
Unknown/Beta emitter	Threat	Other
V-48	Innocent	Medical
W-187	Innocent	Industrial
W-188/Re-188	Innocent	Industrial
Xe-127	Innocent	Industrial
Xe-131m	Innocent	Other
Xe-133	Innocent	Medical
Xe-133m	Innocent	Medical
Xe-135	Innocent	Other
Y-88	Innocent	Other
Y-91	Innocent	Industrial
Yb-169	Innocent	Medical
Zn-62	Innocent	Medical
Zn-65	Innocent	Medical
Zr-95	Innocent	Medical

4.1. Comments on Classify Mode Messages

The following explains the criteria for selected Classify ID Display Mode messages.

HEU (highly enriched uranium)

This message is displayed if the major lines of uranium are detected, and the ratios of the intensities of the lines indicates the ^{235}U content to be above about 70%.

Am241 (unshielded) in the "Industrial" category

This message is displayed if the 59 keV peak is located. It could mean that an ^{241}Am source such as a smoke detector is present. Move closer to the source and/or count longer. This will allow the higher-energy gamma rays to accumulate in the spectrum, in case plutonium is also present.

Unknown peak and **Unknown/Beta emitter**

This indicates the gamma count rate is higher than can be accounted for based on the peaks in the Detective library. The implication is that either an unexpected nuclide or a beta emitter is present (beta emitters typically producing counts over a broad range of energies). Move closer to the source and count longer to determine the nature of the suspect item.

4.1.1. Comments on "Found Nuclide" Screen Messages

RDD Detected

This message is posted when calculated activity is >100 mCi, whether the activity is from threat or innocent nuclides. The gamma count-rate and dose-rate meters on the Survey Mode and ID Mode screens display a flashing red background and extremely high count and dose rates.

5. ADVANCED SETUP

The three-page Advanced Setup menu covers tasks that are not typically required every work session and that require some knowledge of gamma-ray spectrometry and/or radiation monitoring. The Detective saves all settings and uses them until the next time they are changed. Figure 32 shows the first page.

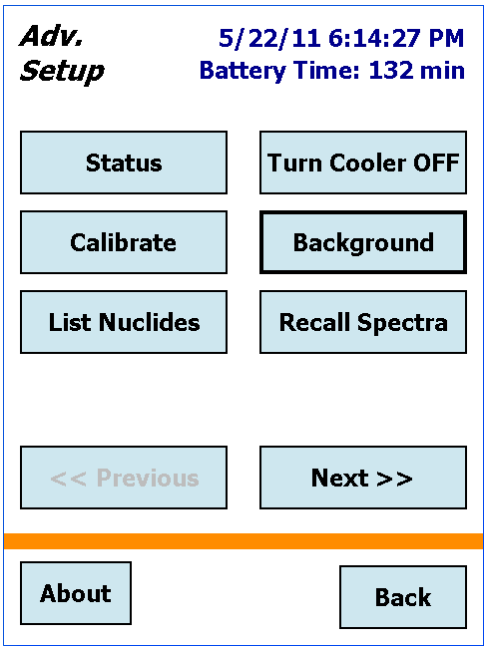

Figure 32. Advanced Setup, First Page.

- Tap the **Next>>** and **Previous<<** buttons to move between the three menu screens.

- Tap **Back** to return to the Survey Mode screen.

NOTE You can set a password on the **Settings** screen (Section 5.2.4.1) to limit access to the second and third pages of the Advanced Setup menu. All users can access the first Advanced Setup page so they can view the hardware status, perform calibrations and background measurements, turn the cooler on/off, etc., as described in the following section.

5.1. Advanced Setup — Page 1

5.1.1. Status

The Status dialog (Fig. 33) allows you to monitor the hardware diagnostic and data acquisition parameters. The default view is a simplified "heads-up" OK/ERR readout. However, you can toggle between the simplified view and the actual readouts (Fig. 34) by tapping three times in the lower-left corner of the screen.

- The **Dead Time** is related to the current gamma count rate, and indicates the percentage of time the MCB is busy (i.e., not available to accept another pulse).[10]

NOTE When the **Dead Time** exceeds 70% because you are near a very high-activity source (whether the source is an innocent or threat nuclide), ***the Detective is not able to process gamma radiation according to its performance requirements. A red indicator in the upper right corner of the screen tells you to MOVE BACK from the source until the dead time drops below 70% so that the unit can perform as specified.*** See Fig. 9 (page 17) and its associated text.

[10]This release of the Detective software does not use the **Live Time** and **Real Time** fields.

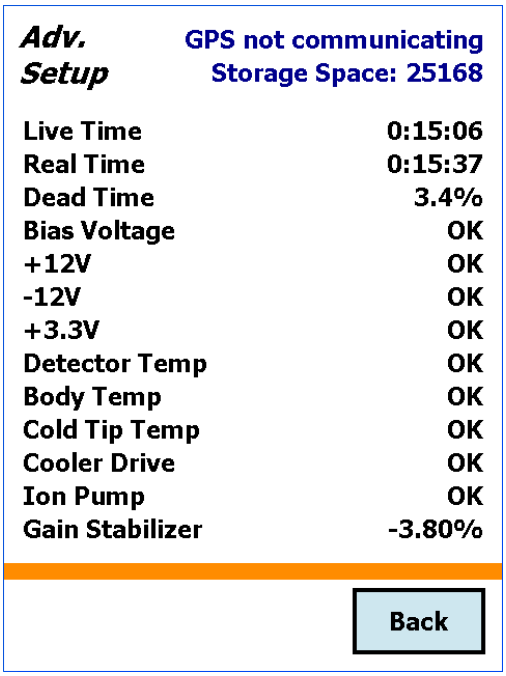

Figure 33. Status Dialog.

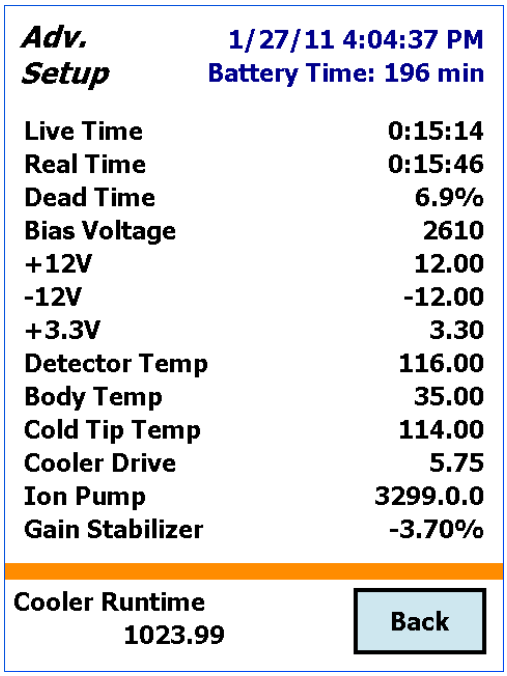

Figure 34. Detailed Status Dialog.

- The remaining indicators are live (i.e., they continuously update to reflect current hardware conditions). For the first few seconds after you open this screen, the nine live indicators typically read Waiting, after which they acquire their actual current values or status messages (e.g., OK, Error, Waiting, OFF).

  On startup and until the detector has cooled and the HV has automatically turned on, **Detector Temp**, **Cold Tip Temp**, and **Bias Voltage** read Error. Once cooldown is complete and the HV automatically turns on, these indicators change to OK. When the cooler is switched off, the **Cold Tip Temp** and **Cooler Drive** indicators read OFF.

  The OK indicator means the parameter is within the allowed limits. The Error indicator means the parameter is outside the limits and must be corrected before the Detective can be used. If the Waiting indicator persists beyond a few seconds *or if you receive an* Error *reading for any of these parameters after the nominal cooldown time has elapsed*, contact your ORTEC representative or our Global Service Center.

When all parameters are within allowed limits, the Survey Mode screen displays the Ready status message.

5.1.2. Turn Cooler Off/On

When the cooler is ON, the button reads **Turn Cooler OFF**. To turn the cooler off, tap this button, then confirm (see Fig. 35). The button title will change to **Turn Cooler ON**. Tap it to restart the cooler. When the instrument has cooled to operating temperature, the bias voltage automatically turns on.

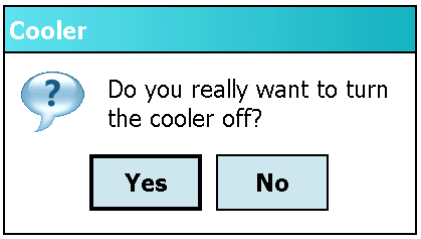

Figure 35. Turn Cooler Off?

NOTE The Detective internal battery does not have enough power to cool down the detector from room temperature, therefore, *external power is required*. In addition, an exhausted internal battery should be charged for 2 hours before the Detective is cooled using external power. If you are using a standard 12 V automobile battery as the external power source, the detector cooling can significantly discharge the battery. Cooler startup without external power cause operational anomalies; see troubleshooting Section 7.5.

You can turn the cooler off for 10–20 minutes without significantly warming the detector. As soon as the cooler is restarted, the Detective typically posts the Ready status within a few seconds. The cooler can be restarted at any time, without harming the detector crystal, regardless of whether the detector is warm, partially cooled, or cooled to the operating temperature range.

5.1.3. Calibrate (Manual)

This command starts the manual calibration routine, which checks and adjusts the Detective's electronics so that it correctly identifies the nuclides in the area. The calibration source to be used must be pre-set within the **Cal. Settings** function, as discussed in Section 5.2.1.

5.1.3.1. Start the Calibration

Position the indicated calibration source in front of the detector window, then tap the **Start Calibration Now** button shown in Fig. 36. The button name will change to **Abort Calibration** and the time remaining to complete calibration will be displayed as in Fig. 37. The time to completion is based on the peak count rate. Calibration will not succeed until the calibration peak passes the quality test.

You can abort the calibration process at any time; no changes will be made to the calibration coefficients (i.e., the existing calibration will still be in effect).

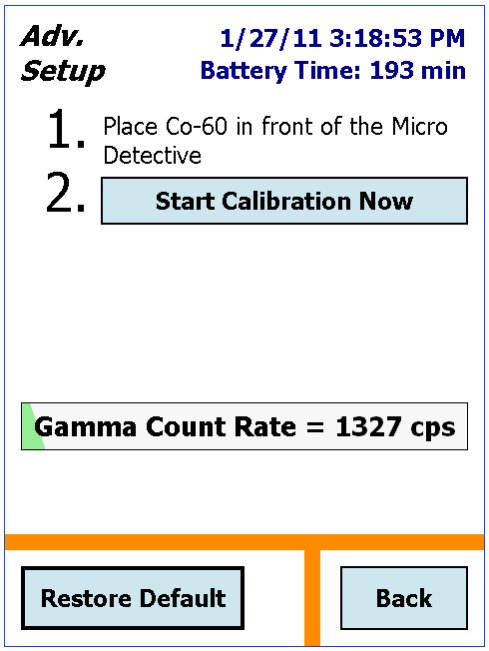

Figure 36. Start Manual Calibration.

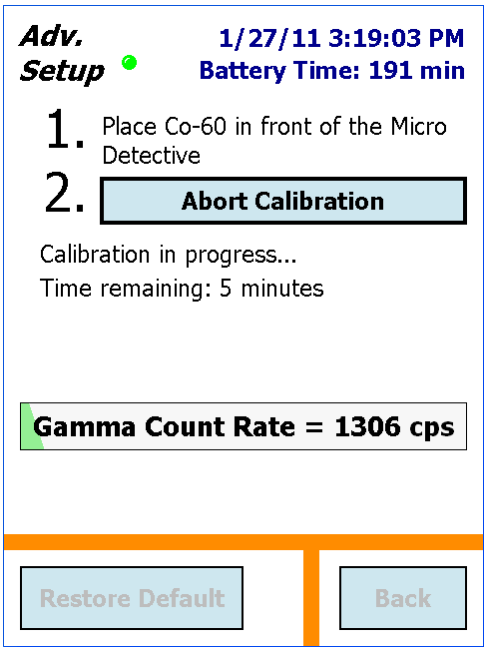

Figure 37. Wait for Completion.

At the end of the calibration period, the **Use Improved Calibration** button will be displayed (Fig. 38), along with the actual energy of the calibration source peak. For the factory-defined sources, the **Centroid** values should ideally be:

- ^{137}Cs — 661.62 keV
- ^{40}K — 1460.75 keV

In addition, the screen will display the full width at half-maximum (**FWHM**), an indicator of peak shape; and the calibration adjustment (**Cal. Adjust**). The calibration adjustment is the difference between the spectrum position of the calibration source's peak in the new calibration and the position of the same peak in the current calibration, expressed in energy, as a percentage of the actual peak energy.

5.1.3.2. Apply the Improved Calibration

When the calibration measurement is complete and the **Use Improved Calibration** button is displayed, choose whether or not to use this new calibration. Usually, the proposed change in calibration is quite small, and sometimes it is even zero. If it is larger than 0.3%, the cause should be investigated. To use the new calibration, tap **Use Improved Calibration**.[11]

[11]If the calibration fails, an error message will be displayed. For more detailed calibration troubleshooting, see Section 7.6.

5.1.3.3. Perform a Background Measurement

If you accept the improved calibration, the manual calibration routine deletes the existing background file. Therefore, the final step of the calibration process is to re-measure the background, as indicated in Fig. 39. Remove the calibration source, tap the **Run a Background** button, then refer to the instructions in Section 5.1.4.

NOTE When the previous background is no longer valid, the Background Invalid message is displayed on the Survey Mode screen. The Identify and Monitor buttons become inactive and the system will not post radionuclide IDs. However, the gamma and neutron count rate meters on the Survey, Search, and SNM Mode screens continue to function normally.

Tap **Back** to return to the Advanced Setup dialog.

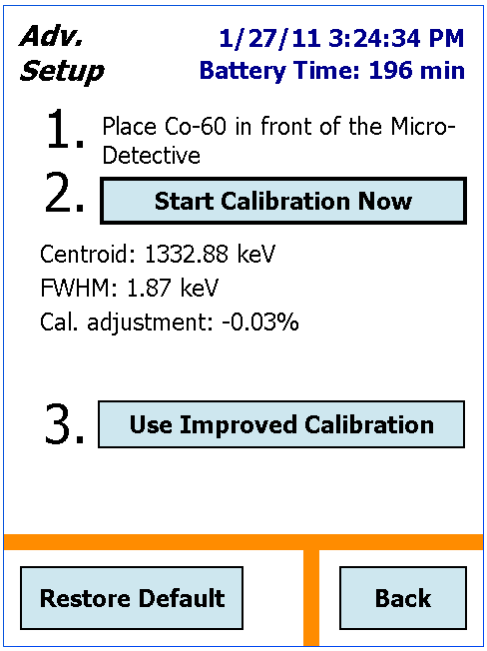

Figure 38. Apply The Calibration.

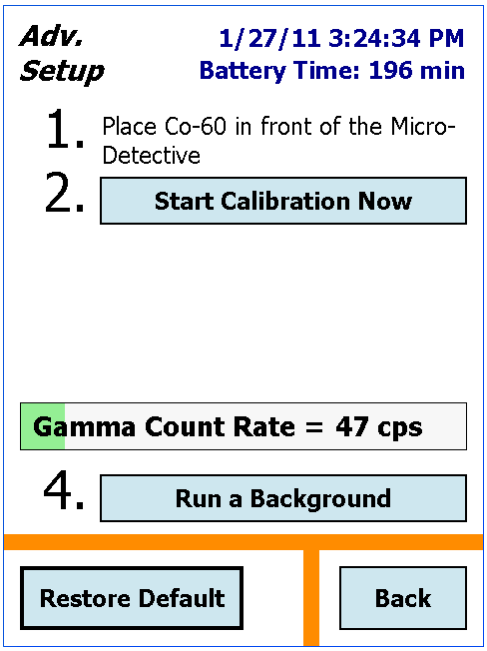

Figure 39. Run A New Background.

5.1.3.4. Restore Default

If you have changed the calibration now or at any time in the past, you can restore the factory calibration settings by tapping on the **Restore Default** button. The factory values are always available. Note that this feature is typically used for troubleshooting purposes. The current background file is destroyed, so you must run a new background before the Identify and Monitor Modes will function..

5.1.3.5. Back

If you do not want to apply the new calibration, tap **Back** to return to the Advanced Setup dialog. (However, if you have run this background as the final step of calibration, remember that you must run a new background before the Identify and Monitor Modes will function.)

5.1.4. Background

This command begins the background radiation measurement pre-configured with the **Bkg Settings** command discussed in Section 5.2.2.

To measure the background:

- Remove all sources from the area.
- Tapping the **Run a Background** button, at the end of the manual calibration routine, opens the screen shown in Fig. 40 and automatically starts the background acquisition.
- Acquisition continues until you tap either **Save** or **Cancel**, which will return you to the **Advanced** menu. *If the measurement is canceled before the minimum time has elapsed, the software does not accept (i.e., save and use) the new background spectrum.* Instead, it reverts to the existing background file.[12]

5.1.5. List Nuclides (View Analysis Library)

This screen (Fig. 41) displays the current library of radionuclide IDs and library version. The complete list of IDs is in Chapter 4. If you wish, you can create a text file listing of the library entries by tapping **Save to File**. This creates the file Nuclides.txt in the Detective's My Documents folder.

5.1.6. Recall Spectra

Recall Spectra lets you view stored .SPC spectrum files and their associated reports. It opens the Choose File dialog (Fig. 42), which displays the **Data Location** listbox and the list of spectra in the currently selected location. Select the desired data location, then use the scrollbar to browse up and down through the list of spectra. Tap **Back** when finished viewing spectra.

[12]As noted elsewhere, if you are running this background as the last step of the manual calibration routine, the Identify and Monitor Modes will be disabled until the background measurement is completed and accepted.

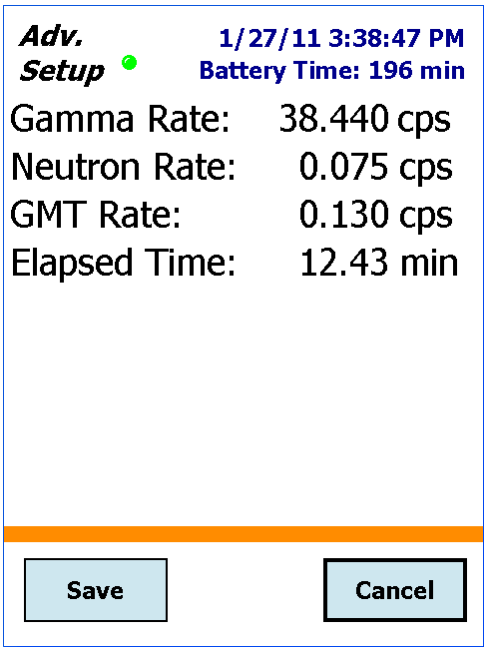

Figure 40. Collect Background for At Least the Specified Minimum Time.

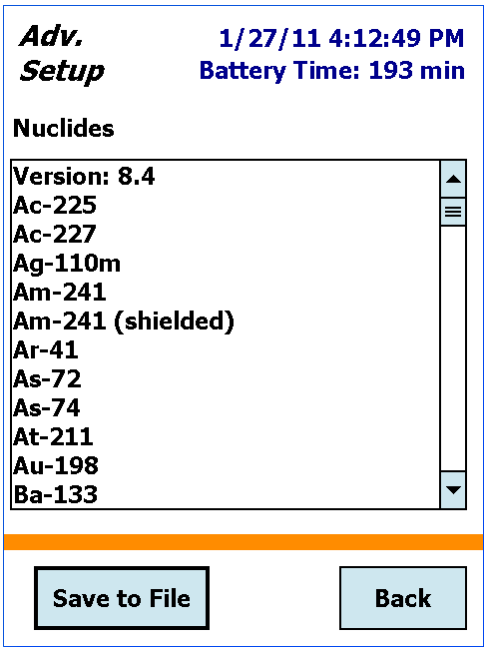

Figure 41. View the Radionuclide Library.

5.1.6.1. Viewing Stored Spectra

To display a particular spectrum file, tap the filename, then tap **Choose**. The histogram will be displayed along with the filename, as shown in Fig. 43. The spectrum display controls are discussed on page 29. To view the associated reports, see the next section.

5.1.6.2. Viewing Stored Spectrum Reports

Identification Mode spectrum files include both the spectrum and information on the radionuclides found during the identification session. When you display a stored spectrum, you can view this information by tapping the **ID** button below the spectrum display. This will open the **ID Report** screen (Fig. 44). Tap the listbox at the top of the screen to access the list of **Found Nuclides** (Fig. 45), **Suspect Nuclides** (for LCX Mode spectra only; Fig. 46), **Top Lines** (Fig. 47), and **GPS** (Fig. 48); some of the reports may contain no entries. Tap **Back** to return to Advanced Setup.

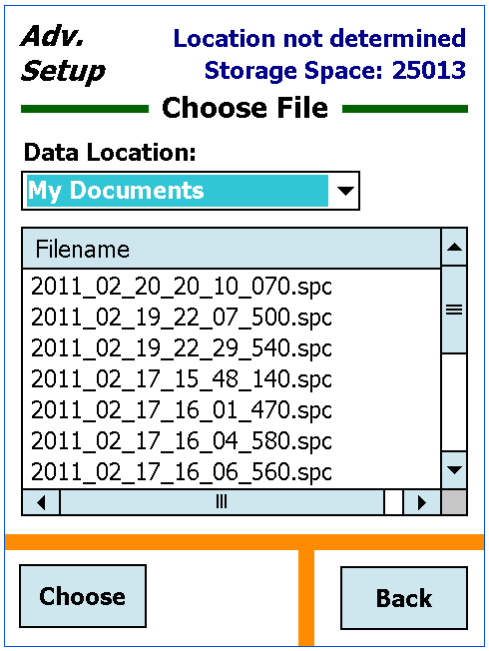

Figure 42. Spectrum Directory.

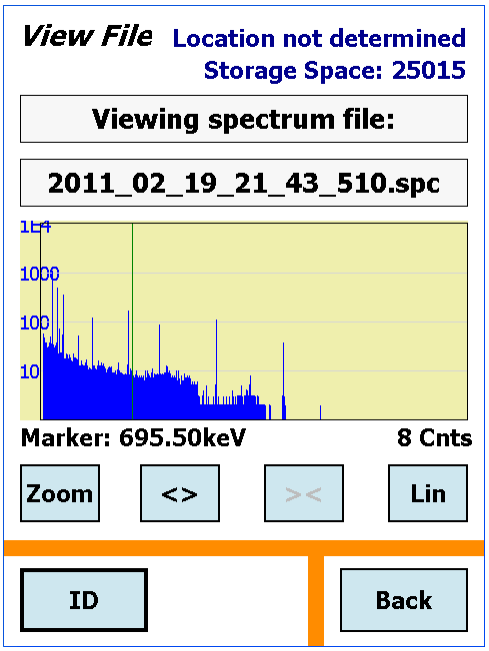

Figure 43. View Spectrum; Tap ID to View Reports.

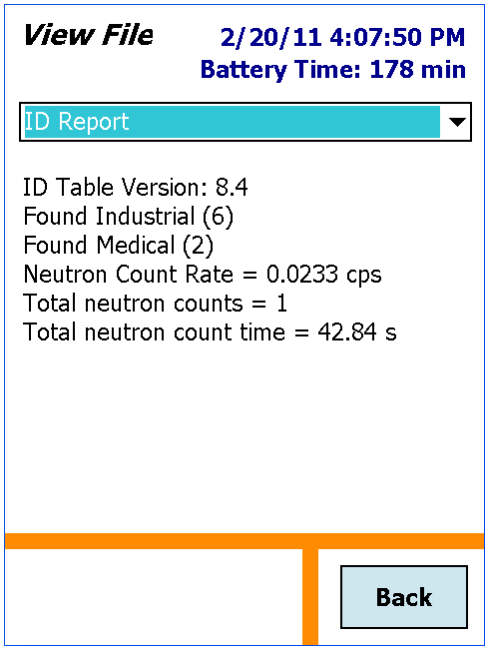

Figure 44. ID Report.

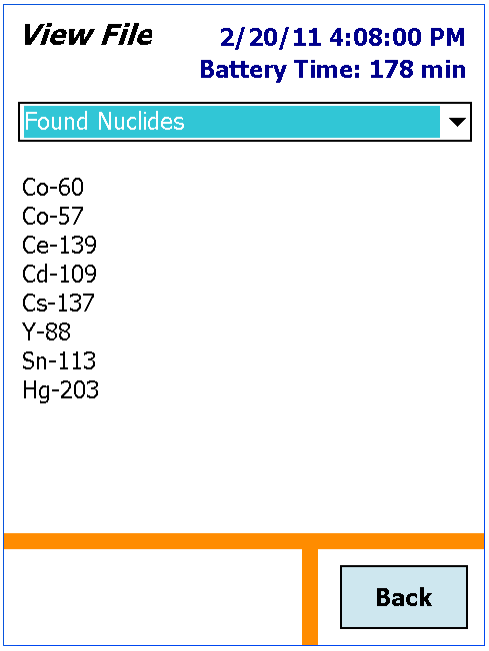

Figure 45. Found Nuclides Report.

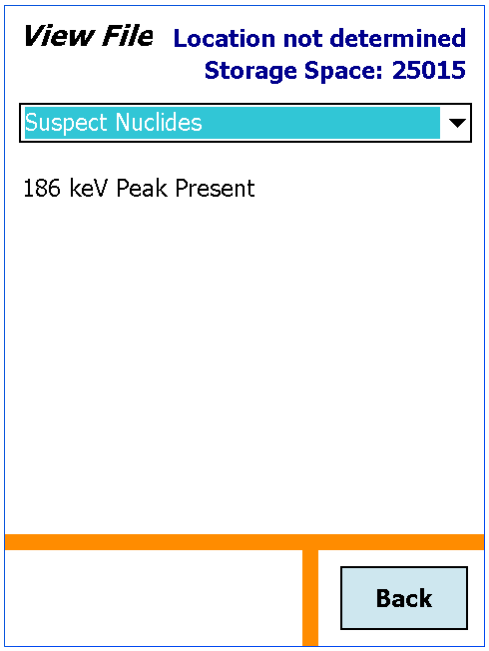

Figure 46. Suspect Nuclide Report (for LCX Mode spectra only).

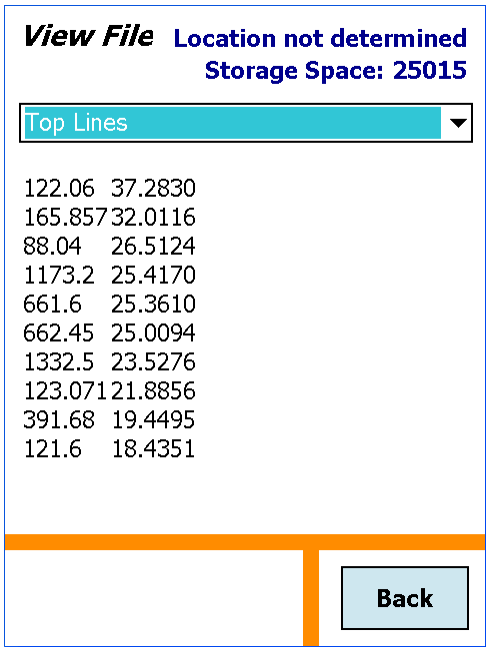

Figure 47. Top Spectral Lines.

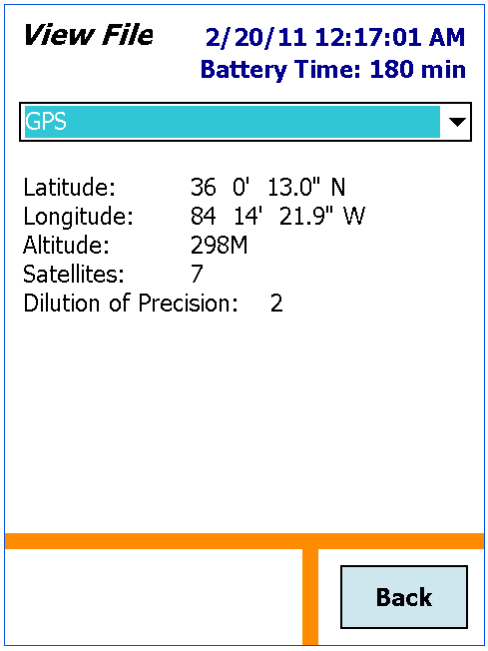

Figure 48. GPS Report.

5.1.7. About

This dialog (Fig. 49) shows the instrument type, presence or absence of neutron detector, firmware and application software version numbers, instrument serial number, and nuclide library version.

The **Firmware Version** prefix is DETH for the Micro-Detective , and DETJ for the Detective-200.

Tap **Back** to return to the Advanced Setup menu.

Figure 49. The About Dialog.

5.2. Advanced Setup — Page 2

If a password has been set, the screen shown in Fig. 50 will be displayed. Tap in the password text box to open the soft keyboard. Enter the password and tap **OK**. If you entered the correct password (which is case-sensitive and treats spaces as characters), the second Advanced Setup page will be displayed (Fig. 51). For more information on the Password screen (including recovery from a lost password), see Section 5.2.4.1.

If the password was incorrect, the Password invalid message will be displayed. You may try to enter the password again or tap **Back** to return to the previous menu page. If no password is set, the Detective will go directly to the second Advanced Setup menu screen.

Figure 50. Enter the Password.

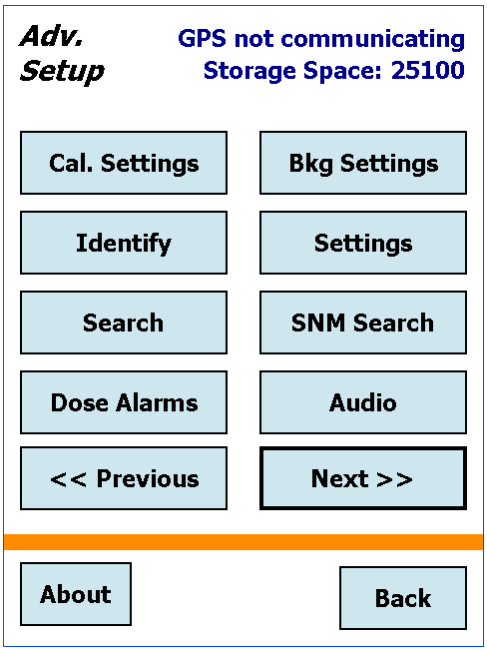

Figure 51. Advanced Setup, Second Page.

5.2.1. Calibration Settings and Auto-Calibration

Cal. Settings (Fig. 52) allows you to turn the auto-calibration check on and off, decide how often to auto-calibrate, and either choose a factory-defined calibration source (^{137}Cs or ^{40}K) or define up to two of your own calibration sources with the **Setup...** feature. The source selected here also determines the source used for the manual **Calibrate** feature discussed in Section 5.1.3.

The calibration routine checks and adjusts the Detective's electronics so that it correctly identifies the nuclides in the area. This function searches for the calibration source peak in a window 30 keV wide, centered on the peak channel for the selected source. Once the peak is located and its net area reaches 4000 counts, the detector amplifier's fine gain setting is adjusted for optimum performance. Unlike manual calibration, auto-calibration does not delete the existing background.chn file so there is no need to take a new background measurement afterwards.

- To choose a calibration source, tap the source list at top left and make your selection.

- To define a calibration source (up to two), tap the **Setup...** button to open the screen shown in Fig. 53. Tap in the **Source Name** field and use the soft keyboard to enter the name, tap in the **Energy Peak** field and enter the peak energy in keV, then tap **Back** to return to the calibration settings screen. The new entry will be available on the source list.

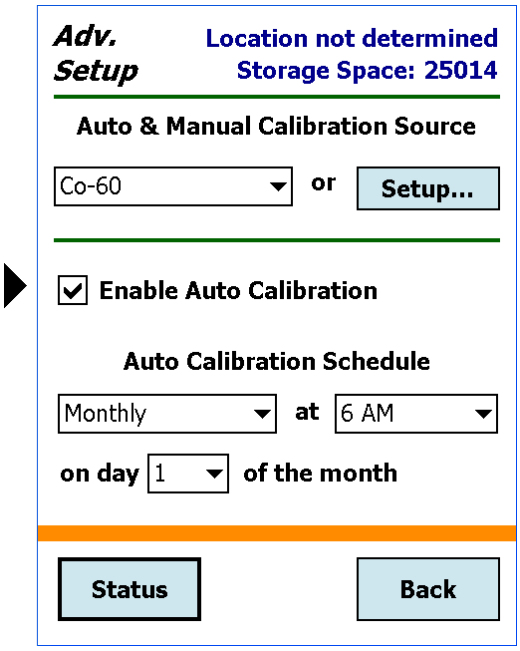

Figure 52. Set Up the Auto-Calibration Feature.

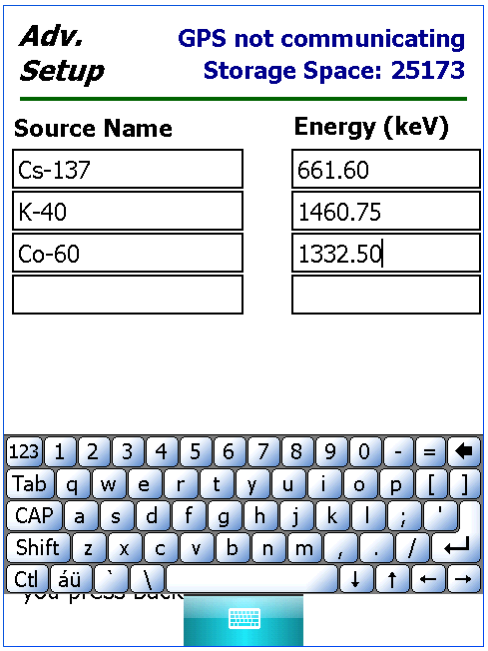

Figure 53. Enter the Peak Energy for a Calibration Source.

- To use the auto-calibration feature, mark the **Enable** box by tapping it. To disable auto-calibration, simply unmark the box. Set the auto-calibration interval by tapping the **Schedule** lists and selecting the desired time of day as well as one of the following intervals:

  — Daily.
  — Weekly; choose the **Day** of the week.
  — Monthly; tap in the **Day of the month** field and use the soft keyboard to enter the day.

5.2.1.1. Setup Requirements for Successful Auto-Calibration

For **Auto Calibration** to run successfully:

- The **Auto Calibration** checkbox must be marked (enabled).
- The Detective must be in Survey Mode (not in another monitoring mode).
- The detector status must be Ready.
- The unit must be properly connected to external power.
- The appropriate source must be in position.

5.2.1.2. Auto-Calibration

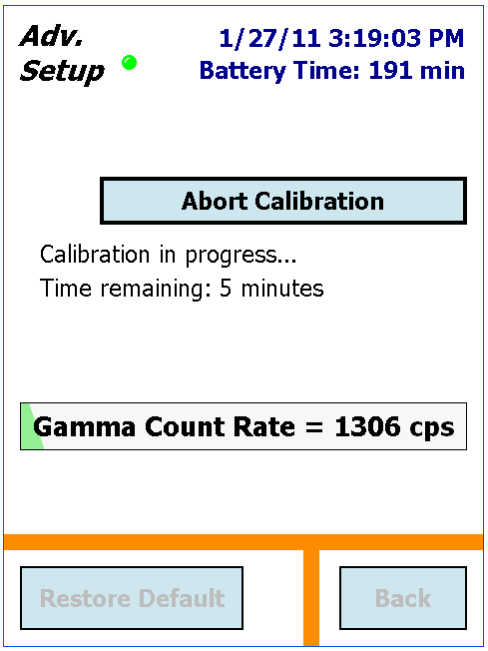

Figure 54. Auto-Calibration in Progress.

- During auto-calibration, the screen displays the time remaining to completion of the calibration, as shown in Fig. 54. This number is the real time for the calibration spectrum acquisition and is based on the peak count rate. *Auto-calibration will not succeed until the calibration peak passes the quality test.*

- If the Detective does not detect the correct calibration source, it will wait for approximately 2 minutes, then posts an error message. Tap **Back** to return to the Survey Mode. You can either use the existing calibration or perform a manual calibration. The unit will auto-calibrate at the next scheduled interval.

- To interrupt auto-calibration, tap the **Abort** button, then **Back** to return to Survey Mode. When you return the Detective to the auto-calibration function, calibration will immediately restart from the beginning. *The unit will continue trying to calibrate until the calibration peak passes the quality test.*

- If you disconnect the instrument from the external power source during auto-calibration, the routine will attempt to run to completion. Tap the **Abort** button to interrupt auto-calibration, then **Back** to return to Survey Mode. When the unit is reconnected to external power, auto-calibration will start at the next scheduled interval.

See also the calibration troubleshooting discussion in Section 7.7 (page 71).

5.2.2. Background Settings

Use this screen to pre-configure the minimum acceptable background radiation measurement time for the **Background** command (Section 5.1.4). The instrument requires periodic measurement of a site's background radiation to reduce false alarms on ^{40}K and other naturally occurring radioisotopes from building materials such as concrete. The background file is saved on the computer in \Program Files\DetectiveEX. It is stored as an ORTEC .CHN spectrum file named background.chn, and is overwritten each time the background is updated. Ideally, a new background measurement should be made whenever the Detective is moved to a new site. In addition, a new background is required as the final step of calibration.

The minimum acceptable data collection time for the background measurement is set on the **Bkg Settings** screen, shown in Fig. 55.

NOTE For optimum counting statistics, we strongly recommend a minimum 30-minute background acquisition (the longer, the better). However, the background settings screen also lets you set a minimum interval of 1, 5, or 15 minutes.

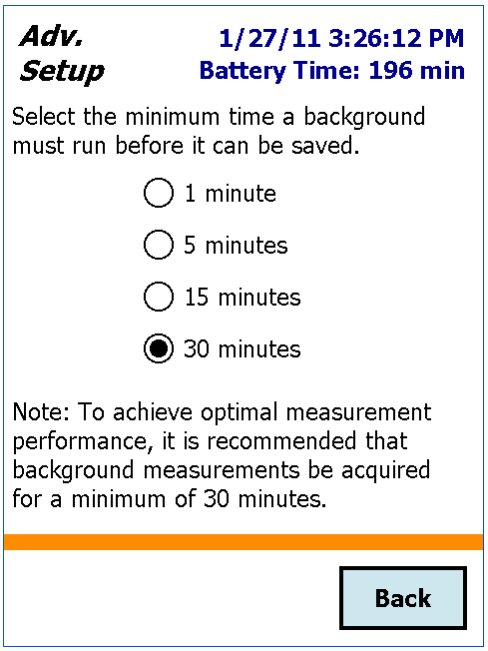
Adv. Setup
1/27/11 3:26:12 PM
Battery Time: 196 min
Select the minimum time a background must run before it can be saved.
1 minute
5 minutes
15 minutes
30 minutes
Note: To achieve optimal measurement performance, it is recommended that background measurements be acquired for a minimum of 30 minutes.
Back

Figure 55. Set the Minimum Background Acquisition Time.

5.2.3. Identify (Identification Mode) Settings

This dialog (Fig. 56) lets you set a counting preset; choose to display radionuclides by category (e.g., Industrial, NORM, Medical, etc.) or by radioisotope name; enable/disable the expert LCX identification mode, and turn color-coded IDs on/off.

5.2.3.1. Real Time Preset

To set a preset acquisition time for Identification Mode, tap in the field to open the soft keyboard, enter a count time from 1 second to 9999999 seconds, and tap **Set**.

In preset mode, the **Pause/Continue** button allows you to extend the count. For more information and an example, see Section 3.2.2.

5.2.3.2. ID Display Mode

Choose whether to display identifications by radio-isotope name (**ANSI**); or by category (**Classify**), for instance, **Industrial**, **Medical**, **NORM-Th**. Figures 19 and 20 on page 25 compare how the same detected radionuclides are displayed in the two modes.

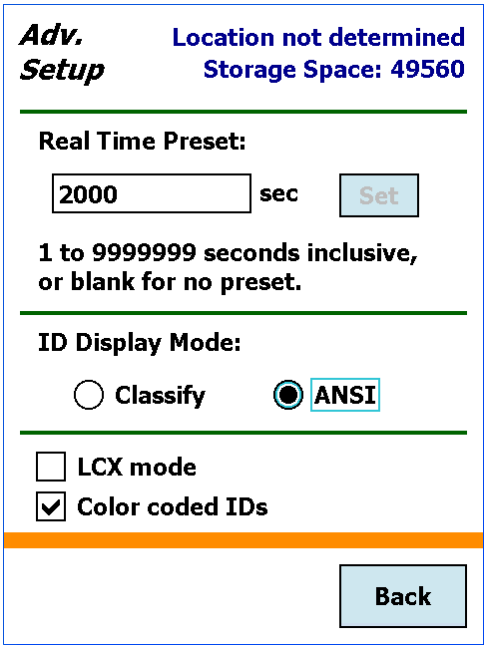

Figure 56. Identification Mode Setup.

See also Chapter 4, which lists all Identification Mode messages, their threat/suspect/innocent status, and Classify mode category.

5.2.3.3. LCX (Low-Confidence Expert) ID Mode

The LCX identification mode displays suspected threat alarms and identifications at an approximately 30% lower confidence level than the normal mode. This results in more hits on suspected threat nuclides. Although detection is arguably improved in LCX mode, the false alarm rate will increase to a level unusable for many applications. *Be aware that the instrument will issue approximately two false suspect threat alarms every hour while in LCX mode.* ***Therefore, we recommend LCX mode only for experienced spectroscopists.***

To enable LCX Mode, mark the checkbox and click on **Back**. A blue simulated LED (🔵) will be displayed in the upper left of all screens, beside the screen title (Figs. 57 and 58). This shows you, at a glance, which radiation monitoring mode is currently selected.

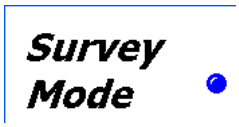

Figure 57.

Figure 58.

Figures 59 and 60 compare how suspect identifications in LCX mode are displayed in the "Classify" and "ANSI" ID Display Modes (both screens reflect the same set of found and suspect substances). Note that in LCX mode, the **Color coded IDs** option is always on.

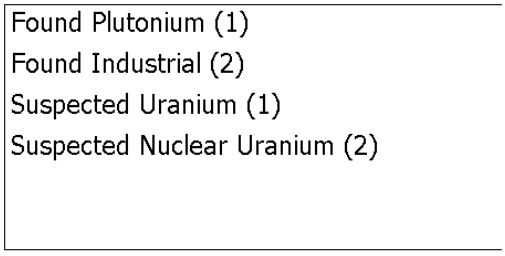

Figure 59. Suspect IDs in "Classify" Display Mode.

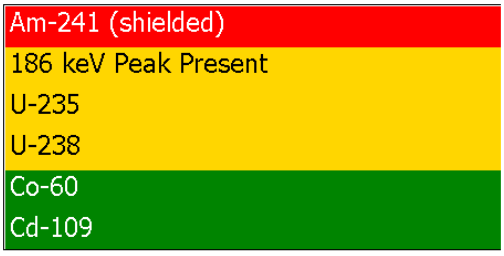

Figure 60. Suspect IDs in "ANSI" Display Mode.

5.2.3.4. Color Coded IDs

When this option is checkmarked (on), ANSI Mode nuclide IDs are displayed on a color-coded background indicating their threat/suspect/innocent status (refer to Figs. 19, 27, and 60). As noted in the preceding section, this option is always on in LCX mode.

5.2.4. Settings

5.2.4.1. Password

The **Settings** screen (Fig. 61) allows you to set a password to prevent unintended changes to the Advanced Setup parameters. The password is ***case sensitive***, alphanumerical, can include spaces, and can be of any length. There is no factory default.

To set the password, tap in the **Password** field to open the soft keyboard. Enter the password and tap **Set**. The soft keyboard will close. To put the password into effect, tap **Back** to return to the Survey Mode screen.

To remove the password, tap the end of the password, delete all the characters by tapping the backspace soft key (⬅), then tap **Set**. *Tapping the spacebar to overtype the characters does not work* (i.e., there is no overtype capability, and the "space" is treated as any other character).

NOTE ***There is no master password*** *so be sure to record your password, including upper-case and lowercase letters.* If you lose this password, contact your ORTEC representative or our Global Service Center for assistance.

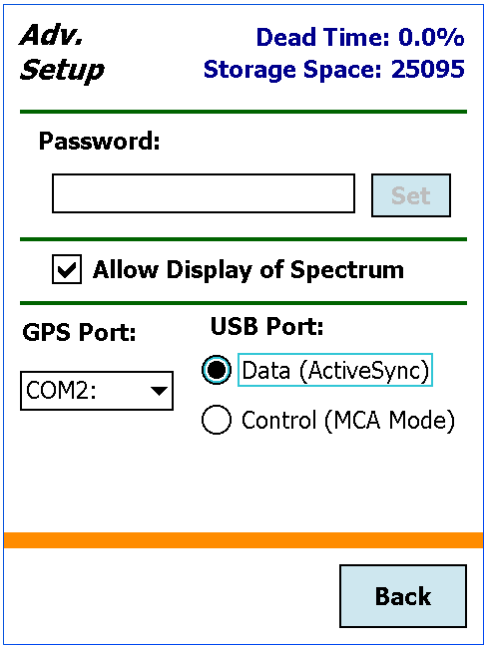

Figure 61. The Settings Screen.

5.2.4.2. Allow Display of Spectrum

This allows an administrator to hide the Display Mode by locking the spectrum display. When the display is locked, none of the **Display** buttons will be shown on the dialogs. To lock the display, tap the checkbox to mark it. To restore access to the spectrum display, tap the checkbox again to unmark it.

- To prevent spectra from being viewed on the Detective screen, unmark the **Allow Display of Spectrum** checkbox, then set a password in the Advanced Setup dialog (Section 5.2.4.1).

- If the spectra must not be viewed at any time by anyone, we additionally recommend that the field operator not save them.

NOTE If spectra are saved (whether or not the Display Mode is locked), a properly configured computer and MAESTRO can still be used to view the saved spectra. In such cases, the Detective (and any memory cards containing spectra) must be secured from unauthorized access according to your site operating procedures.

5.2.4.3. GPS Port

The factory setting is COM2; do not change it.

5.2.4.4. USB Port

This feature allows you to control whether the Detective functions as a standalone identifier or as a full-featured MCB with high-resolution HPGe detector.

Data (ActiveSync)

This setting is used for normal, standalone Detective operation. This is also the setting used to transfer search and identification spectra to a computer via Windows Mobile Device Center (Windows 7 or 8) or ActiveSync (Windows XP). In this mode, you do not have access to the MCA hardware functions.

Control (MCA Mode)

This setting gives you access to the Detective's high-performance HPGe detector and MCA for use with MAESTRO and other CONNECTIONS applications, as described in Chapter 8. In this mode, all normal Detective functions are disabled. When you select this option, the screen appears as shown in Fig. 78 on page 75.

5.2.5. Search Mode Settings

This dialog (Fig. 62) allows you to set the data **Collection Time** for Search Mode. Search Mode tracks the total counts vs a specified period of time and presents the results in a "strip chart" emulation. The total counts in each time period are represented on the vertical scale, and the time period always occupies one pixel width on the display (that is, changing the dwell time does not change the width of the lines on the strip chart). Tap to select a dwell setting. As soon as you choose a new setting, it will go into effect.

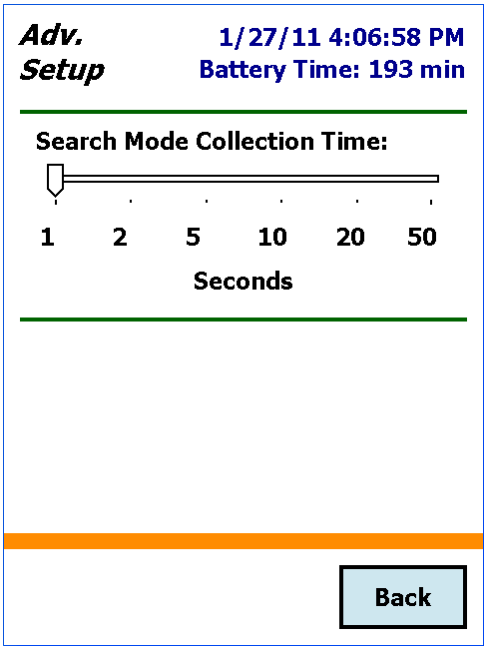

Figure 62. Search Time per Horizontal Unit Selection.

5.2.6. SNM Mode Settings

Use this dialog (Fig. 63) to set the search acquisition **Dwell Time** for the SNM Search Mode (Section 3.5); and the detection thresholds for **Pu-239**, **U-235**, and **Neutron** radiation.

Advanced users can also choose to enable and configure a detection threshold for the plutonium surrogate **Ba-133** for training and site setup purposes (see the discussion in Section 3.5). If the **Ba-133** search is enabled, four bar graphs will appear on the SNM Search Mode screen instead of just three (see Fig. 28 on page 32). The **Dwell Time** setting is the same for all SNM radioisotopes.

To set the **Q Alarm Threshold** for each gamma emitter, tap the radioisotope name, tap in the threshold field to open the soft keyboard, enter the desired value, and tap **Set**. Figure 63 shows the setup dialog for **Pu-239**.

To set up the **Neutron** count rate (for units so equipped), in counts per second, tap the **Neutron** tab, tap in the threshold field to open the soft keyboard, enter the desired value, and tap **Set**.

To enable the **Ba-133** search (Fig. 64), mark the **Include in Search** checkbox and enter the desired alarm threshold value, then tap **Set**. When this feature is disabled, the **Ba-133** bar graph is not displayed on the SNM Search Mode screen.

Tap **Back** to return to the Survey Mode screen.

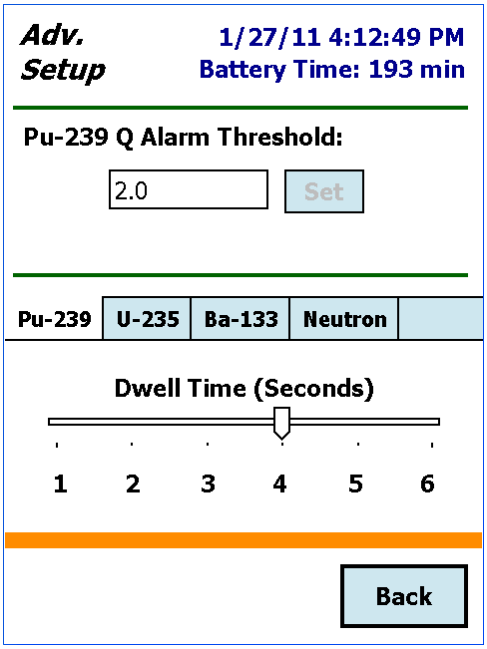

Figure 63. Configure the SNM Search.

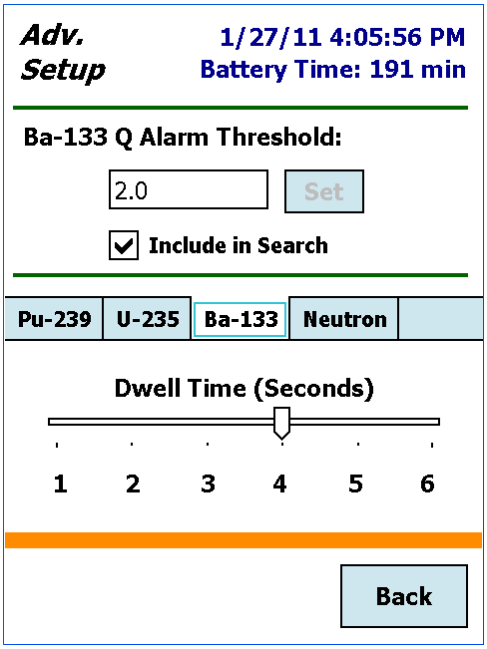

Figure 64. Enable the Ba-133 Search and Alarm Threshold.

5.2.7. Dose-Rate Units and Alarms

In all modes, the Detective alarms audibly and visually at a gamma dose rate of 10,000 µSv/hr (1 rem/hr) and/or the neutron count rate >500 cps. Above these limits, the ID Mode's Found Nuclide screen reports the message RDD Detected. The Dose Alarms dialog (Fig. 65) lets you optionally set lower thresholds for one or both types of radiation.

To set either **Threshold**, tap in the field to display the soft keyboard. Enter the desired value and tap **Set**.

You can choose display the gamma dose rate in microSieverts per hour (**µSv/hr**) or millirem per hour (**mrem/hr**). The **Dose Units** status message updates immediately to reflect the new dose-rate unit. To change units, tap either the **µSv/h** or **mrem/h** radio button to mark it.

5.2.8. Adjust Audio Volume (Micro-Detective only)

This feature (Fig. 66) lets you adjust the speaker and headphone volume or **Mute** all audio signals. The **Gamma Sensitivity** slider sets the number of gamma counts per audio click.

When finished, tap **Back**.

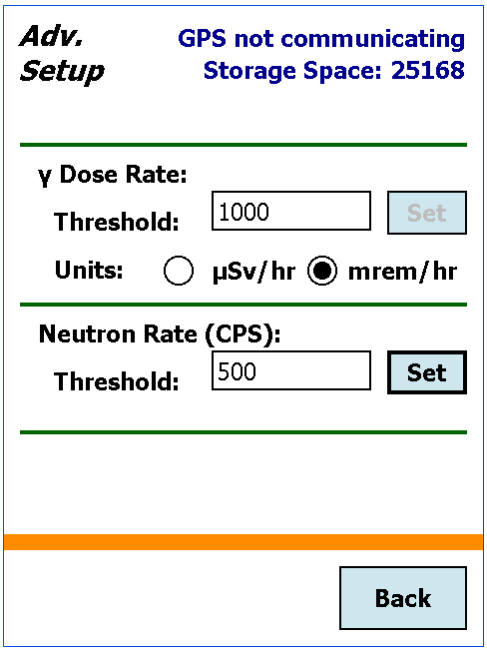

Figure 65. Set the Dose Rate Units and Alarm Thresholds.

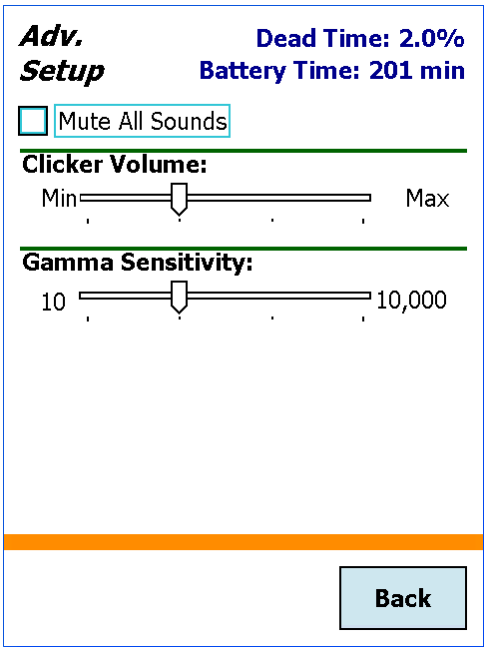

Figure 66. Adjust the Audio Volume.

5.3. Advanced Setup — Page 3

To access the third Advanced menu page (Fig. 67), tap the second page's **Next>>** button.

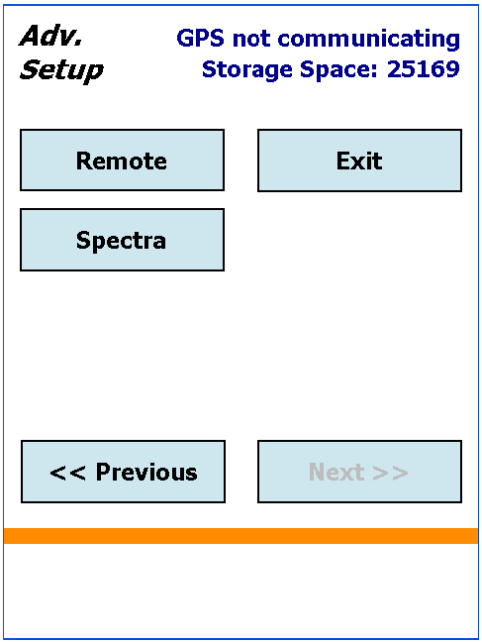

Figure 67. Advanced Setup, Third Page.

5.3.1. Remote

This screen is used by other ORTEC applications, such as the Detective-Mobile® system.

5.3.2. Exit

The **Exit** button is used to close the Detective software application and go to the computer operating system. This is not normally used, but could be needed from time to time. A confirmation dialog is displayed before the program exits. To return to the Detective program without exiting, tap **Cancel**. To restart the Detective application, tap **Start**, then locate and tap the **Detective** program shortcut. (The application executable file is located in the My Device\Program Files\DetectiveEX folder.)

5.3.3. Spectra

The **Spectra** command opens the screen shown in Fig. 68, which lets you choose sample description options, the file storage location, and the file save formats. In addition, you can delete spectrum files.

The top right of the screen shows the number of spectra that can be stored in the current storage location (refer to Fig. 8). File types and filenaming conventions are given in Section 1.4.2.

To view stored .SPC spectra and their associated reports, use the **Recall Spectra** command (Section 5.1.6).

Stored spectra can be downloaded to a computer according to the instructions in Chapter 6.

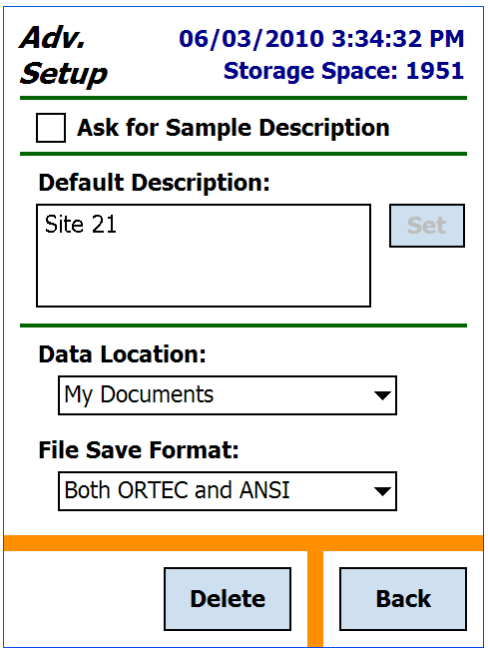

Figure 68. Spectrum Description and Location Settings.

5.3.3.1. Ask for Sample Description

You can optionally store a spectrum description/comment with each spectrum you save. If you mark this checkbox, each time you save a spectrum, an "ask for description" dialog will open so you can add a description or modify the current **Default Description** (discussed next).

5.3.3.2. Default Description

This option lets you save a default sample description/comment with every spectrum file. Tap in the dialog to display the soft keyboard, and tap **Set** to save your entry. You can also use this with the **Ask for Sample Description**. In that case, when you save a spectrum, an "ask for description" dialog will open, giving you the option of adding to, modifying, or even deleting the current default description. This is a good way to enter the main portion of the description ahead of time, then add a unique identifier, such as a sequence number, to each spectrum as it is acquired.

5.3.3.3. Data Location

This field (Fig. 69) allows you to choose the storage device or location for the spectrum storage. The location you choose becomes the default location on the spectrum display dialog. Tap the down arrow to open a list of valid locations, which for the Detective are (1) the SD card, which is indicated as Storage Card/Data; and (2) the computer's My Documents folder. If the SD card is not present in its slot, it will not be on the list. Tap the location you want.

5.3.3.4. File Save Format

The Detective application generates two basic types of files:

- Identification Mode gamma-ray spectra.
- Search Mode "strip chart" histograms of gamma (and optional neutron) count rate vs. time.

The **File Save Format** feature (Fig. 70) lets you choose to generate these files as ORTEC file formats, ANSI N42.42 format files (compatible with ANSI N42.42-2006), or both. For more detailed information on file formats, see Section 1.4.2.

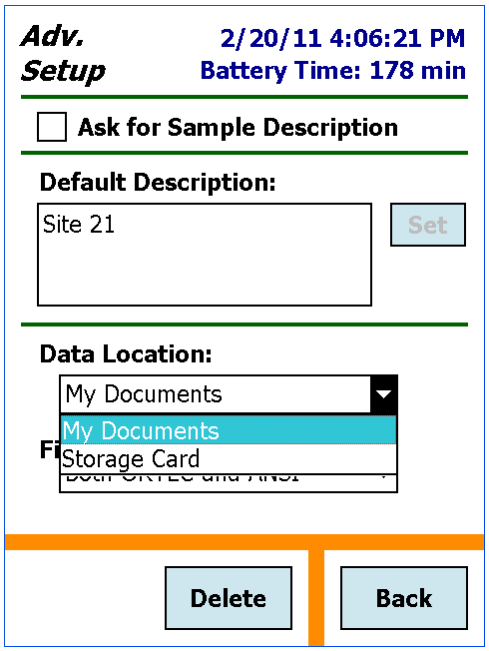

Figure 69. Select the Data Location.

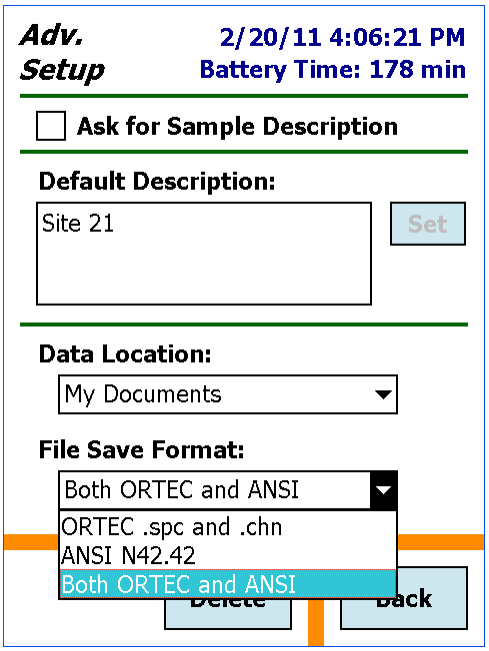

Figure 70. Select the Data Format(s).

5.3.3.5. Delete Stored Spectra

To delete a stored spectrum file, tap **Delete**. This opens the Choose File dialog (Fig. 71), displaying the **Data Location** listbox and the list of spectra in the current location. Select the desired data location, then scroll up and down through the list of spectra. Files in .SPC format are listed first, in descending alphabetical order, followed by .N42 files in descending alphabetical order, as shown in the figure. To delete a spectrum, tap the name and then tap **Choose**. You will be asked to either confirm or cancel the deletion. Tap **Back** when finished deleting spectra.

IMPORTANT	*There is no "undo" for this action!*

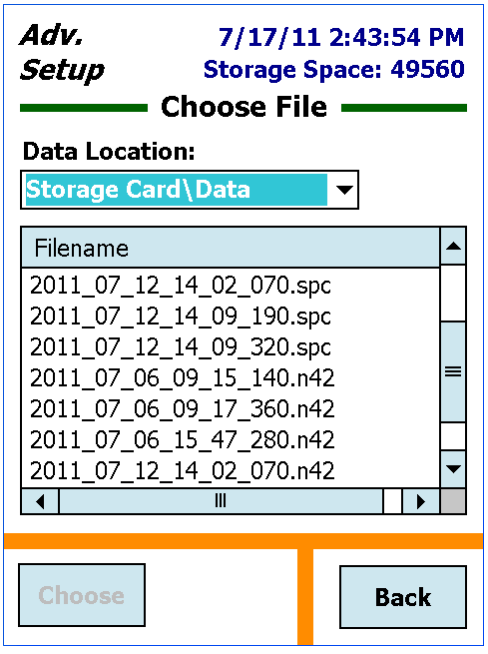

Figure 71. Delete Spectrum Files.

6. FILE TRANSFER TO COMPUTER

The Detective stores Identification Mode spectra in the ORTEC .SPC and ANSI .N42 file formats, and Search Mode spectra in the simpler .CHN format. ORTEC files downloaded to a computer can be viewed and analyzed with CONNECTIONS programs such as MAESTRO, GammaVision, and ISOTOPIC. The file transfer method depends on your computer operating system and where your spectrum files are stored on the Detective.

- Spectra stored in the SD card's Data folder: The simplest method is to move the card to a computer with a memory card reader and Windows Explorer. Otherwise, transfer files using ActiveSync or the Windows Mobile Device Center as described below.

- Spectra stored in the Detective's My Documents folder:

  — **Windows 7**: Download and install Windows Mobile Device Center, as described in Section 6.1, then copy files via Windows Explorer.

  — **Windows XP**: Download and install Microsoft ActiveSync driver, as described in Section 6.2, then copy files via Windows Explorer.

IMPORTANT *Before connecting the Detective to a computer for the first time*, install Active-Sync or Windows Mobile Device Center ***first***. Otherwise, the Detective may not be able to communicate properly with the computer; for troubleshooting, see Section 7.9.

6.1. Windows 7

1) Download and install the free Windows Mobile Device Center v6.1 or higher from the Microsoft Download Center. Follow the wizard prompts, restart the computer, then start the Windows Mobile Device Center program.

2) If the Detective is in MCA Mode, tap the **Data (ActiveSync)** option to return it to standalone identifier mode (see Section 5.2.4.4).

3) Connect the Detective's USB port to the computer. If this is the first time the Detective has been connected to this computer, Windows will display a series of "new hardware" messages indicating a mobile device (e.g., the Detective computer) has been detected and its driver installed. Windows Mobile Device Center will then take several seconds to communicate with the Detective and indicate the its integrated computer is **Connected** (Fig. 72). If Windows Mobile Device Center cannot connect to the Detective, see the troubleshooting steps in Section 7.9.

4) Click on **Connect without setting up your device**. This will prevent the host computer and Detective from automatically synchronizing (i.e., exchanging files). ***Do not modify the Program and Services, transfer graphics or music to the Detective computer, or change the Mobile Device Settings.***

IMPORTANT *Remember that the Detective is not to be used for purposes beyond the monitoring tasks described in the user manual, and no changes should be made to the operating system settings. Doing so could void your warranty.*

5) Hover over **File Management** to expand its topics, and click on **Browse the contents of your device** (Fig. 73).

6) Windows Explorer will open and the Detective's computer will be listed as shown in Fig. 74. Stored search and identification files will be located in the My Documents folder or the SD card's Data folder, depending on the location set on the Spectra dialog (see Section 5.3.3.3).

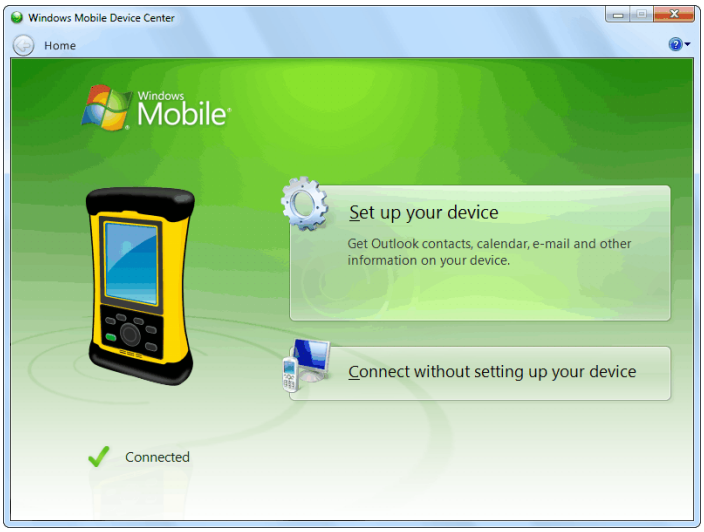
Windows Mobile Device Center
Home
Windows Mobile
Set up your device
Get Outlook contacts, calendar, e-mail and other information on your device.
Connect without setting up your device
Connected

Figure 72. The Detective is Connected to the PC.

Figure 73. Choose the File Management Browse Option.

7) If your files are on the SD card, select the Storage Card and open the Data folder. If your files are stored in the My Documents folder, select the root (\ ) entry, then Documents.

Identification Mode spectra in the .SPC format have a "spectrum" icon with a green background. Search Mode files in the .CHN format have a spectrum icon with a gray background. ANSI (.N42) files have the default file icon.

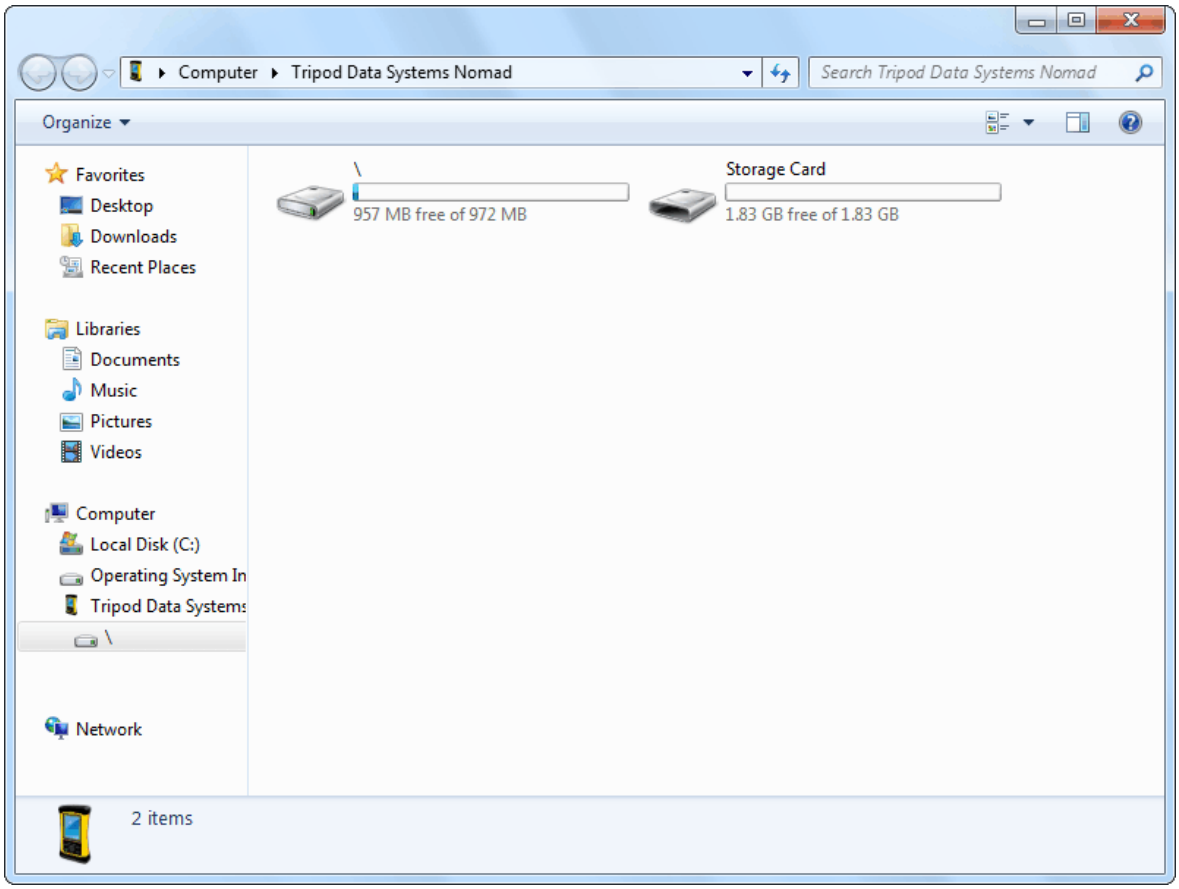

Figure 74. The Detective Computer's Top-Level File Structure.

6.2. Windows XP

1) Download ActiveSync v4.5 or higher from the Microsoft Download Center. This is a free download. When download is complete, select **Run**. This will automatically start installation. Follow the wizard prompts and restart the computer.

2) If the Detective is in MCA Mode, tap the **Data (ActiveSync)** option to return it to standalone identifier mode (see Section 5.2.4.4).

3) Connect the Detective's USB port to the computer. If this is the first time the Detective has been connected to this computer, Windows will display a series of "Found New Hardware" messages indicating a mobile device has been detected. The Synchronization Setup Wizard will start. Follow the wizard prompts for a standard partnership.

4) On the Synchronization Options screen, ***unmark ALL checkboxes, scrolling down as needed to ensure all items have been deselected*** (Fig. 75). This will prevent the host computer and Detective from automatically exchanging files.

IMPORTANT *Remember that the Detective is not to be used for purposes beyond the monitoring tasks described in the user manual, and no changes should be made to the operating system settings. Doing so could void your warranty.*

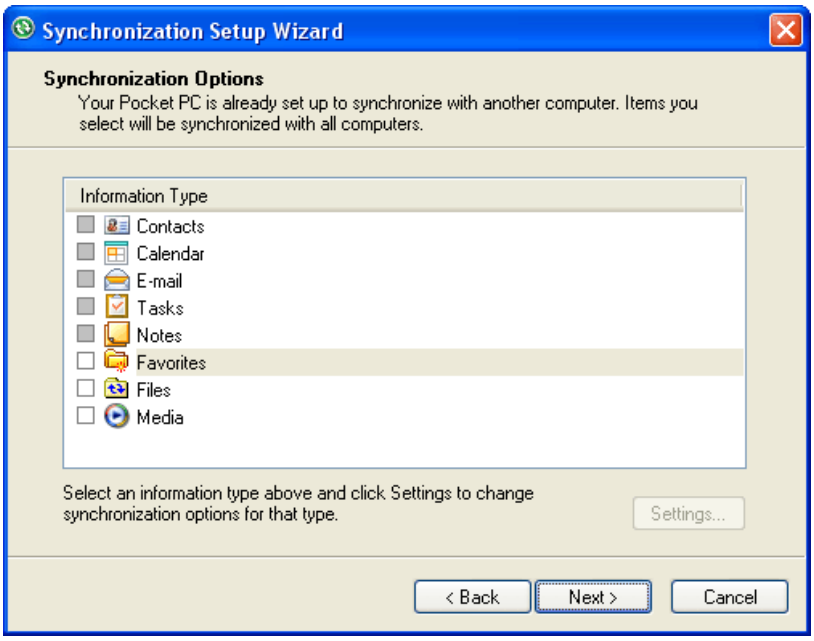

Figure 75. Unmark All Synchronization Options.

5) Continue with installation as directed. At the end of the wizard, the ActiveSync dialog will indicate the Detective computer is **Connected** (Fig. 76). If ActiveSync cannot connect to the Detective, see the troubleshooting steps in Section 7.9.

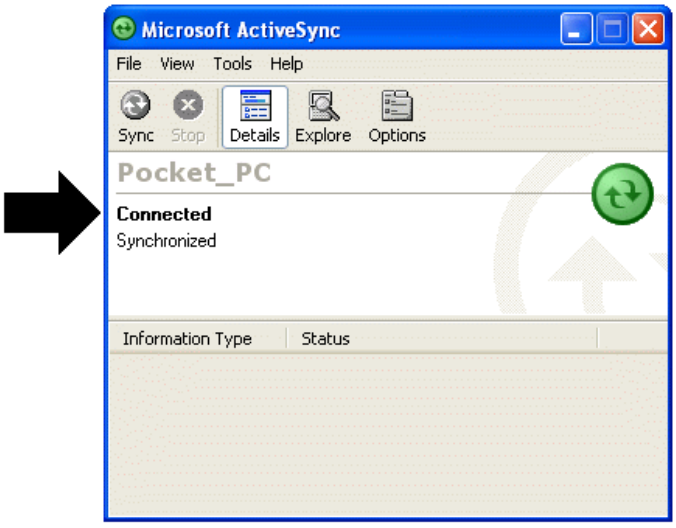

Figure 76. Connection Established.

6) You can now click on the **Explore** toolbar button in the ActiveSync dialog to open Windows Explorer and view the new connection and its menu tree.

From the host computer, the Detective is displayed as My Windows Mobile-Based Device in the Mobile Device folder under My Computer (Fig. 77). Stored search and identification files will be located in the SD card's Data folder or the My Documents folder depending on the location set on the Spectra dialog (see Section 5.3.3.3). These locations are indicated by arrows in Fig. 77.

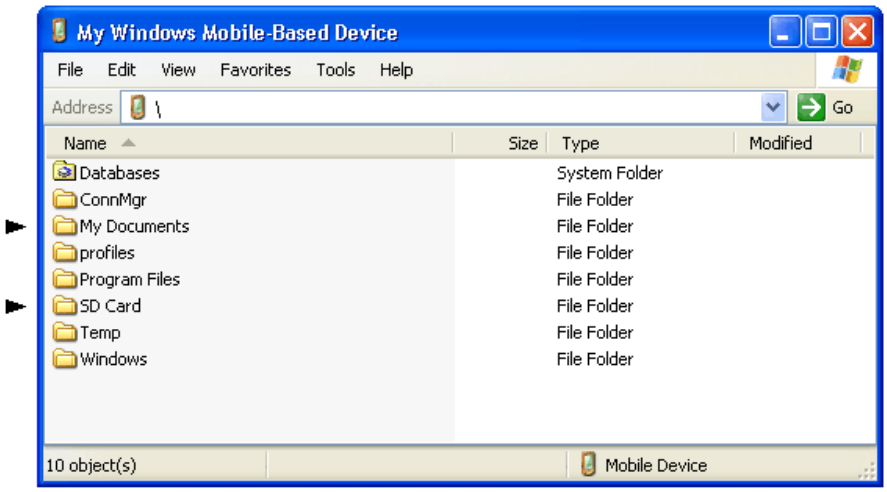

Figure 77. Exploring the Detective Computer's Files from the ActiveSync Window.

6.3. When File Transfer Is Complete

To return the Detective to standalone service, simply disconnect it from the USB cable.

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7. TROUBLESHOOTING

7.1. "Error Saving .SPC File" Message

This message is generated if you are saving spectrum and search files to SD card, and (1) the card is removed during a **Save** operation; or the storage medium is defective. If you removed the card, reinsert it and tap **Save** again. If the card is defective, replace it and tap **Save**. If you do not have a replacement card, you must stop the current identification session without saving (in which case, the spectrum will be discarded), go to the Spectra dialog (Section 5.3.3.3), and tap a valid location.

If this error occurs when saving files to the computer's My Documents folder, contact your ORTEC representative or our Global Service Center.

7.2. If the Detective Program Stops

The Detective incorporates a computer running the Windows Mobile operating system. Occasionally, the operating system will stop responding to external commands. The power button is located below the display on the lower-right corner of the computer's bezel. Press and hold the power button until the computer shuts down and restarts; this may take 10–20 seconds (the mechanical cooler will continue running). This will reset the operating system and automatically relaunch the Detective application.

7.3. If You Drop the Detective

The Detective has been designed to be a rugged instrument, and should survive reasonable levels of mechanical abuse. It has been drop-tested to destruction in development and is known to have a high degree of survivability to "normal" shock and vibration.

If the instrument is dropped:

- Disconnect from any external power source, disconnect any USB connection, and press and hold the **On/Off** button for approximately 20 seconds. Wait 5 seconds, then turn the unit back on. This should reset any mechanical relays that might have been deactivated by the drop.

- Inspect the exterior for evidence of mechanical damage or distortion.

- *Listen* to the cooler: If you hear any unusual noises (rattling or pinging) emanating from the cooler, contact your ORTEC representative or our Global Service Center.

- Monitor the unit for the next few hours to ensure that it remains Ready (indicating that the cooler and bias voltage are functioning properly), calibrates successfully, and correctly identifies the specified calibration source. If, on recalibration, a *large* adjustment is proposed (>0.3% or more), this could indicate a problem.

If the unit fails in one or more of these respects or if one or more hardware diagnostic settings (Section 5.1.1) indicate a hardware failure, contact your ORTEC representative or our Global Service Center for further assistance. *Remember that there are no user-serviceable parts inside the Detective, and opening the case will void the warranty.*

7.4. If the Detective Will Not Turn On

- Connect the Detective to an external power source; it should automatically boot up, turn the cooler on, and start the Detective software application. The unit can start the cooler using internal battery power, but *must* be connected to an external power source to fully cool a warm detector.

- If the internal batteries have become exhausted but can still hold a charge, see the next section.

- If the battery does not hold a charge, ensure that it is properly installed. If it is properly installed but still does not hold a charge, it must be replaced according to the instructions in Chapter 10.

7.4.1. Starting from an Exhausted Battery

If the internal battery is completely exhausted:

- Connect the Detective to external power. The cooler will start automatically. If the detector has warmed up, it will be cooled to operating temperature before the battery begins recharging. If the battery is completely discharged, it will typically reach full charge in 3–4 hours after the detector has cooled.

- If the cooler does not automatically restart, go to the Advanced Setup menu and tap **Turn Cooler On**.

If the problem persists, contact your ORTEC representative or our Global Service Center for assistance.

7.5. If the Display is Lost or Posts a "Display Disabled" Message

- Press and hold the On/Off button, located on the base of the display, until the shutdown warning screen counts down and the display goes dark. Wait 15–20 seconds, then press the On/Off button to restart the computer. When restart is completed, the Detective program will automatically start and the unit will be ready for use.

For further assistance, contact your ORTEC representative or our Global Service Center.

7.6. If You Forgot the Password

There is no master password. Contact your ORTEC representative or our Global Service Center for assistance.

7.7. Calibration Issues

7.7.1. Calibration Takes Very Long to Complete or Does Not Finish at All

- Make sure your calibration source corresponds to the source or peak energy selected on the calibration settings screen (Section 5.2.1).

- If the amount of time remaining (see Fig. 37) is lengthy, use a higher-activity calibration source or position the source on the detector endcap.

- If the calibration routine does not complete (i.e., if it continues running beyond a few minutes), tap **Abort Calibration**, correct the situation, and restart the calibration.

7.7.2. The Centroid, FWHM, or Calibration Adjustment Value Has Changed Dramatically Since the Last Calibration

This is a highly unlikely occurrence. The Detective is an advanced digital design and highly stable when operating correctly.

- If the energy calibration appears highly variable, contact our Global Service Center or your ORTEC representative. Routine changes of the order of 0.05% are to be expected. This might simply be due to counting statistics in the spectrum. A change much larger than this, say 0.5%, bears investigation. Apparent changes in the reported FWHM calibration are most likely to be statistical variations. If the (gain) calibration adjustment value is stable, the unit is functioning properly.

- If large changes in the calibration continue to occur, contact our Global Service Center or your ORTEC representative.

7.8. GPS Issues

7.8.1. Delayed Display of Location Coordinates

If your GPS has not received signals from GPS satellites for >30 days (e.g., if it has not been in use or has been used continuously indoors), it may take 10–15 minutes for the unit to update and begin displaying location information.

7.8.2. "GPS Not Communicating"

This message (see Fig. 31, page 42) is displayed if the Detective software loses contact with the GPS unit. Go to the **GPS Port** list on the Settings screen (Section 5.2.4.3) and make sure the COM2 port is selected. If the "not communicating" message continues to be displayed after you close the Settings screen, contact your ORTEC representative or our Global Service Center.

7.9. Windows Connectivity Problems

Typically, if ActiveSync or Windows Mobile Device Center cannot find the Detective, it is because the Windows connectivity software was not installed ***first***, before the unit was connected to the computer. If the Windows connectivity software has not been installed, when you attach the Detective to the computer for the first time, the "new hardware" bubbles in the lower right corner of the screen will indicate that device driver installation failed.

- Confirm the USB cable is good. If connecting via a USB hub, ensure that it is correctly connected and functioning. If this does not resolve the issue, go to the next step.

- In Control Panel, open the Device Manager and check for an **Unknown Device** entry that disappears when you disconnect the Detective from the computer. If such an entry exists, reconnect the Detective, right-click on the **Unknown Device**, select **Uninstall**, and confirm that you wish to uninstall the instrument. Disconnect the Detective from the computer.

- Download and install (or uninstall and reinstall) the ActiveSync or Windows Mobile Device Center software, making sure you have downloaded the correct version; restart the computer; and start the connectivity program.

- Restart the Detective by pressing and holding the On/Off button for 5 seconds, until the screen goes dark and the instrument reboots. When the Detective program has fully

reinitialized, reconnect to the computer. You should see one or more “new hardware” bubble messages indicating the Detective was successfully detected.

- If these steps do not resolve the issue, contact your ORTEC representative or our Global Service Center. In the meantime, if your spectrum files are stored in the instrument’s My Documents folder, you may wish to exit the Detective program, use the computer’s File Explorer program to copy the spectra to an SD card, then mount the SD card in the computer and transfer the files that way.

7.10. Troubleshooting MAESTRO-Related Problems

7.10.1. MAESTRO Does Not Connect with the Detective

If properly installed and functioning MAESTRO software (or other CONNECTIONS programs) cannot find and communicate with the Detective when it is connected via the USB port and being used as an MCA:

- Make sure the USB cable is properly connected to both the Detective and computer.
- Make sure USB hubs are correctly connected and functioning.
- Make sure the Detective is turned on, the USB port setting is in **MCA Mode** on the **Settings** screen.
- Check the Master Instrument List on the computer to ensure that the Detective-EX is on the list. If it is not listed, manually run the MCB Configuration program from the Windows Start menu. See the MAESTRO *User’s Manual* for detailed instructions on this operation.

7.11. Other Problems with the Detective

Should the Detective exhibit other unusual behavior, confirm that the Regional Settings in the Windows Mobile operating system are set correctly, and restore them if necessary. The Detective is designed to function with Windows Mobile set to the **English (United States)** region and its default values for decimal symbol, digit grouping symbol, and time and date formats, as described below. *Using other than the factory default settings can cause operational problems.*

To check these settings:

- On the third page of the Advanced Setup menu, tap **Exit**, then confirm that you wish to end the Detective program (Section 5.3.2).

- On the Windows desktop, tap the **Start** square in the upper left corner of the screen, then tap **Settings**.
- In the Settings dialog, tap the System tab, then select **Regional Settings**.
- On the Region tab, select **English (United States)** from the listbox.
- On the Number tab, choose the period (**.**) for the **Decimal symbol** and the comma (**,**) for the **Digit grouping symbol**.
- On the Time tab, select *h:mm:ss tt* as the **Time style** and the full colon (**:**) as the **Time separator**.
- On the Date tab, use *M/d/yy* as the **Short date**, the forward slash (**/**) as the **Date separator**, and the **Long date** format *dddd, MMMM dd, yyyy*.
- Tap the upper right **OK** circle, then the upper right **X** circle to return to the Windows desktop.
- Restart the Detective as described in Section 7.2.

For further assistance, contact your ORTEC representative or our Global Service Center.

8. USING THE DETECTIVE WITH ORTEC SPECTRUM ANALYSIS PROGRAMS

The Detective is intended for independent, standalone operation, with no computer required. However, when you connect it to a computer running recent ORTEC CONNECTIONS spectroscopy applications, such as MAESTRO or GammaVision, you can use the it as a high-performance HPGe spectrometer/digital MCA.

Note that only limited hardware adjustments are allowed. The Detective prevents changes to the hardware settings, in MAESTRO, that might affect the unit's performance as an identifier. For example, you cannot change amplifier gain, conversion gain, and other similar settings. Using CONNECTIONS driver v6.09.06 or later will allow you to view the stored spectrum reports described in Section 8.3.8. The MAESTRO *User's Manual* contains complete instructions on software installation, network protocol setup, and configuration of the MCBs attached to your computer. When installing MAESTRO, choose the **USB-Based Instruments** selection to install the correct driver for the Detective.

When you disconnect from the computer and exit its MCA Mode, all previous (normal operation) settings, including the calibration, are immediately restored and the Detective is ready for normal use as a standalone identifier.

8.1. Connecting the Detective to a Computer

From the Advanced Setup menu, tap **Settings**, then tap the **Control (MCA Mode)** radio button. This sets the Detective's USB port so the instrument's MCA can be connected to a host computer. The other Detective features are disabled. The Detective can then be used as a high-performance HPGe MCA controlled by MAESTRO and other ORTEC CONNECTIONS spectroscopy applications. Within approximately 3 seconds after entering MCA Mode, the Detective screen changes to the display shown in Fig. 78.

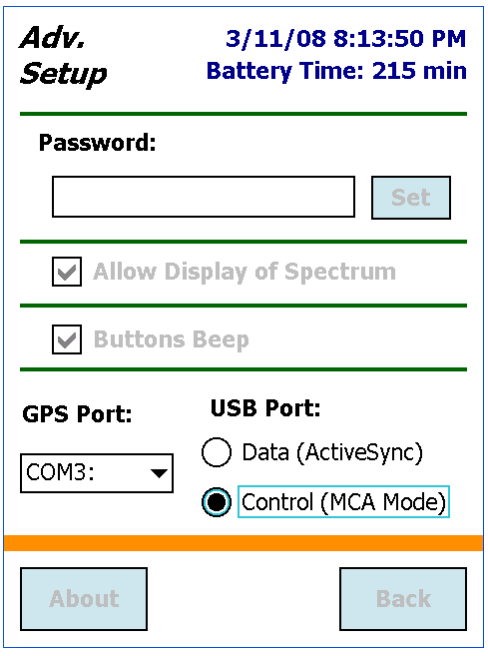

Figure 78. Detective Ready For Use As MCA.

The first time this Detective is connected to a particular computer for use as an MCA, Windows runs a "found new hardware" installation sequence. If asked for the location of the Detective driver, select the "automatically locate the driver" option, answer any remaining prompts, and close the wizard.

Follow all installations for the CONNECTIONS Driver Update Kit and MAESTRO, including running the **MCB Configuration** program accompanying MAESTRO to build a *Master Instrument List* of all ORTEC MCBs accessible to the computer.

To return the Detective to standalone operation, simply tap the **Data (ActiveSync)** radio button.

NOTE MAESTRO and other ORTEC applications have a **Lock/Unlock Detector** command to prevent unauthorized users from changing detector settings, starting and stopping data acquisition, and clearing the detector memory. This locking command functions separately from the Detective administrative pass-word. If the Detective is password-locked in MAESTRO, you can still use it in the field without knowing the password. However, the next time you use it in MCA Mode with MAESTRO, it will still be locked.

8.2. Quantitative Analysis of Detective Spectra in GammaVision and ISOTOPIC

The Detective can be used to collect data for quantitative analysis, either as a standalone field instrument or a benchtop MCB connected to a computer. In both usage modes, the data can be stored as .SPC format spectrum files. The .SPC files can then be quantitatively analyzed on a computer using GammaVision or ISOTOPIC.

Note, however, that the Detective is not designed to store efficiency information in the .SPC files it creates. Therefore, for quantitative determinations, special attention is needed to prepare the calibration (.CLB) file so that GammaVision or ISOTOPIC will add the efficiency information during processing.

To prepare this calibration file, load a Detective calibration spectrum into GammaVision or ISOTOPIC. Use the software application's **Calibration Wizard** to obtain the additional efficiency calibration, keeping the existing energy calibration. After the efficiency calibration is computed, save the complete set of calibrations as a .CLB file.

To add the efficiency information to an existing .SPC file (typically from a standalone Detective):

- Transfer the .SPC file from the Detective to the computer (see Chapter 6).
- Recall the .SPC file in GammaVision or ISOTOPIC.
- Load the .CLB file containing the proper efficiency information. This can be done either with the program's **Recall Calibration** command; or by specifying the .CLB file as the calibration override in the GammaVision analysis options (.SDF) file or the ISOTOPIC configuration.

- Save the .SPC file with or without further analysis.

NOTE If the .CLB file is specified in the GammaVision .SDF file or ISOTOPIC configuration, the .An1 file generated during analysis will contain the proper calibration information but the original .SPC file (without the efficiency information) will not change.

To load the efficiency information before acquiring a new spectrum (with the Detective attached to a computer):

- Load the .CLB file with the **Recall Calibration** command; or by specifying the .CLB file as the calibration override in the GammaVision .SDF file or ISOTOPIC configuration.

- Acquire a new spectrum and save it in .SPC format.

8.3. MCB Properties in MAESTRO

This section discusses the hardware setup dialogs you will see within MAESTRO when you use the **MCB Properties...** command on the **Acquire** menu. The MCB Properties dialog contains all of the instrument controls including acquisition presets, high voltage, hardware status indicators, and amplifier settings. To view the hardware parameters and Identification Mode reports for spectra downloaded from the Detective, simply move from tab to tab. Click on **Close** when finished.

When setting up a data acquisition, note that as you enter characters in the data-entry fields the characters will be underlined until you move to another field or until 5 seconds have lapsed since a character was last entered. During the time the entry is underlined, no other program can modify this value.

NOTES The changes you make on most property tabs take place immediately. There is no cancel or undo option for this dialog.

In MAESTRO, the **Download Spectra** and **View ZDT Corrected** commands on the **Acquire** menu and the **Smooth** and **Strip** commands on the **Calculate** menu are disabled for this instrument.

8.3.1. Amplifier

Figure 79 shows the Amplifier tab, which displays the **Coarse** and **Fine Gain** and **Pole Zero** controls.

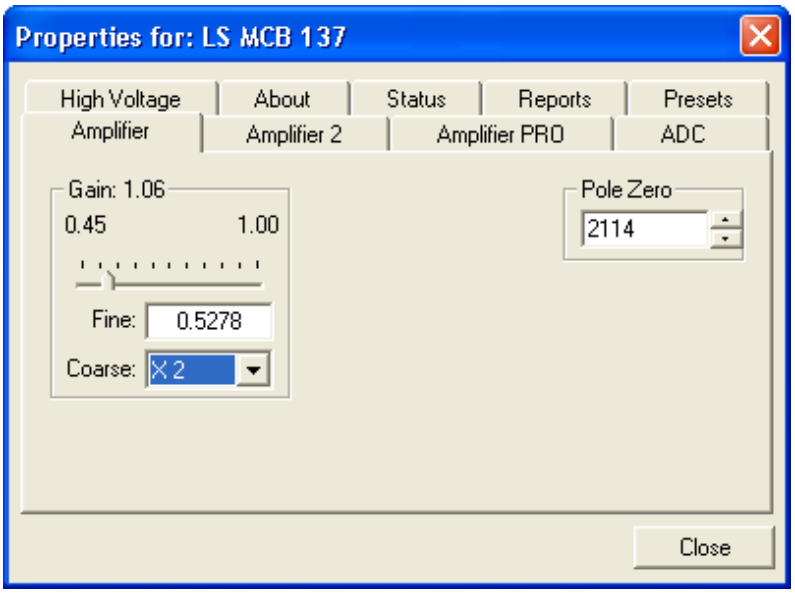

Figure 79. Amplifier Tab.

8.3.1.1. Gain

Set the amplifier coarse gain by selecting from the **Coarse** listbox, then adjust the **Fine** gain with the horizontal slider bar or the edit box, in the range of 0.45 to 1.00. The resulting effective gain is shown at the top of the **Gain** section. The two controls used together cover the entire range of amplification from 0.45 to 32.

8.3.1.2. Pole Zero Adjustment

To maintain optimum energy resolution and peak position stability to high counting rates, it is important to enter the correct value for the pole-zero cancellation. Use the default value as the starting point.

To make a fine adjustment of the **Pole Zero** setting:

1) Use a radioactive source that produces a well-defined peak near the upper limits of the energy spectrum. At low counting rates, note the symmetry of the peak.

2) Move the source closer to the detector to achieve much higher counting rates. If the peak maintains the symmetry observed at low counting rates no further adjustment of the **Pole Zero** is needed. If high counting rates generate a tail on the high energy side of the peak, slightly decrease the pole-zero value until the tail disappears. If high counting rates generate a tail on the low-energy side of the peak, slightly increase the pole-zero value until the tail disappears.

3) Make a final adjustment to balance the symmetry of the peak as closely as possible to the symmetry observed at low counting rates. This will result in the optimum pole-zero adjustment.

8.3.2. Amplifier 2

Figure 80 shows the Amplifier 2 tab, which accesses the advanced shaping controls including the InSight™ Virtual Oscilloscope mode.

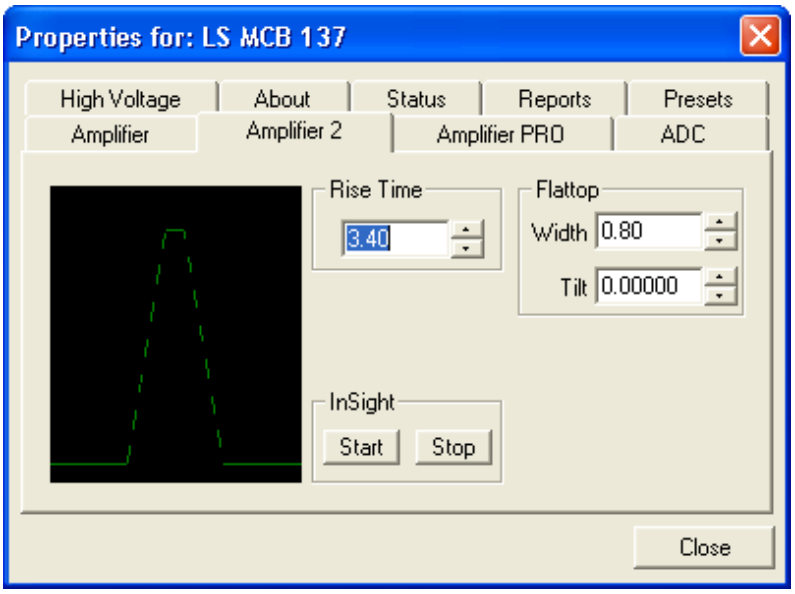

Figure 80. Amplifier 2 Tab.

8.3.2.1. Shaping Controls

The many choices of **Rise Time** let you precisely control the tradeoff between resolution and throughput. Starting with the default value, you should increase the rise time for better resolution for expected lower count rates; or, when unusually high count rates are anticipated, reduce the rise time for higher throughput with somewhat worse resolution.

Use the up/down arrows to adjust the **Rise Time** within the range of 0.8 to 23.0 µs.

For the more advanced user, the InSight mode allows you to directly view all the parameters and adjust them interactively while collecting live data. To access the InSight mode, go to the **Insight** section on the Amplifier 2 tab and click on **Start**. The InSight mode is discussed in detail in the MAESTRO *User's Manual*.

The **Rise Time** value is for both the rise and fall times; thus, changing the rise time has the effect of spreading or narrowing the quasi-trapezoid symmetrically.

The **Flattop** controls adjust the top of the quasi-trapezoid. The **Width** adjusts the extent of the flattop (from 0.3 to 2.4 µs). The **Tilt** adjustment varies the "flatness" of this section slightly. The **Tilt** can be positive or negative (range: −1.0 to +0.99219). Choosing a positive value results in a flattop that slopes downward; choosing a negative value gives an upward slope.

The dead time per pulse is $(3 \times \textit{Rise Time}) + (2 \times \textit{Flattop Width})$.

When you are satisfied with the settings, **Close** the Properties dialog and prepare to acquire data.

Once data acquisition is underway, the advanced user might wish to return to the Amplifier 2 tab and click on the **Insight** section's **Start** button to adjust the shaping parameters interactively with a "live" waveform showing the actual pulse shape.

8.3.3. Amplifier PRO

Figure 81 shows the Amplifier PRO tab, which contains the **Low Frequency Rejector** (LFR)[13] filter control. Turning it off causes shifting and/or broadening of peaks in addition to the acquisition of noise in the lowest-energy channels. We strongly recommend the LFR be enabled during all data acquisitions. Note, however, that you must turn the LFR *off* to pole-zero the Detective. Subsequent measurements can then be taken with the LFR filter on.

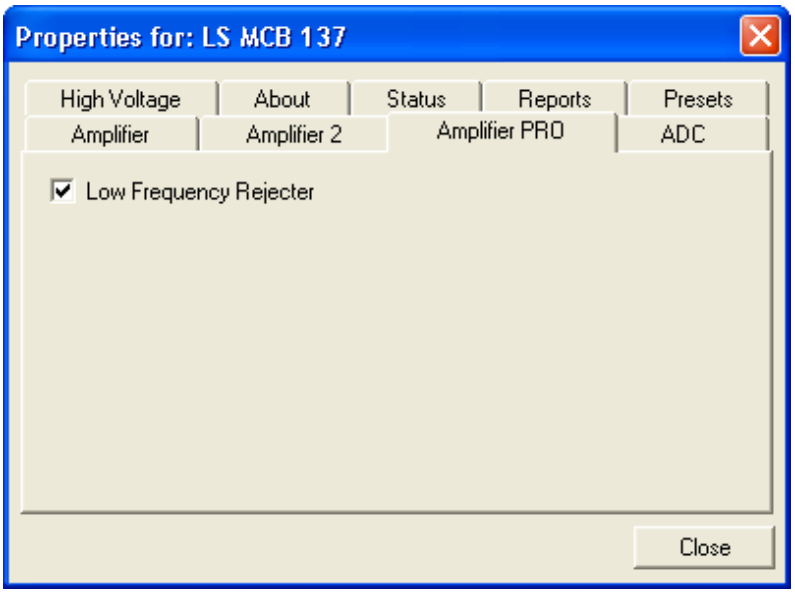

Figure 81. Amplifier PRO Tab.

8.3.4. ADC

This tab (Fig. 82) contains the **Conversion Gain**, **Lower Level Discriminator**, and **Upper Level Discriminator** controls. In addition, the current real time, live time, and count rate are monitored at the bottom of the dialog.

In standalone mode, the Detective operates at a fixed **Conversion Gain** of 8192 channels, and the LLD and ULD are fixed at 40 and 8191, respectively. However, in MCA Mode, the maximum conversion gain is 16384 channels.

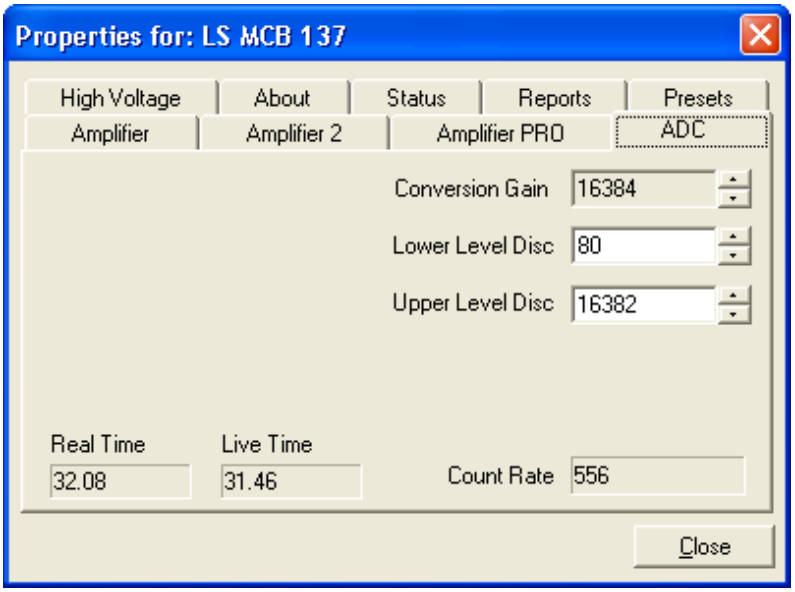

Figure 82. ADC Tab.

The **Conversion Gain** sets the maximum channel number in the spectrum. If set to 16384, the energy scale is divided into 16384 channels. This parameter is entered in powers of 2 (e.g., 8192, 4096, 2048, 1024, 512). The up/down arrow buttons step through the valid settings.

The **Lower Level Discriminator** sets the level of the lowest amplitude pulse that will be stored.

[13]Patent pending.

This level establishes a lower-level cutoff by channel number for ADC conversions. Because of the mechanical cooler, we recommend a minimum setting of 40 (in addition to leaving the LFR on at all times).

The **Upper Level Disc**riminator sets the level of the highest amplitude pulse that will be stored. This level establishes an upper-level cutoff by channel number for storage.

8.3.5. High Voltage

Figure 83 shows the High Voltage tab, which allows you to turn the bias voltage off and on, and monitor the **Actual** bias. You cannot adjust the bias voltage, nor can you change the **Shutdown** mode, which is fixed as **SMART**.[14]

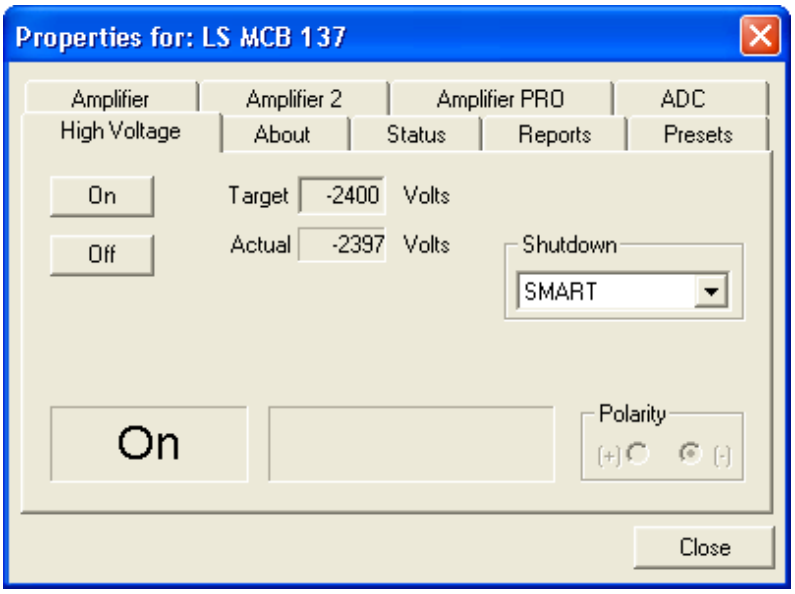

Figure 83. High Voltage Tab.

[14]This is a reference to the Detective's SMART-1® detector technology. For more information on SMART-1, see the ORTEC catalog or visit www.ortec-online.com.

8.3.6. About

This tab (Fig. 84) displays hardware and firmware information about the Detective as well as the data **Acquisition Start Time**. In addition, the **Access** field shows whether the MCB is currently locked with a password by MAESTRO. **Read/ Write** indicates the MCB is unlocked and **Read Only** means it is locked. See the note concerning passwords on page 76, at the end of Section 8.1.

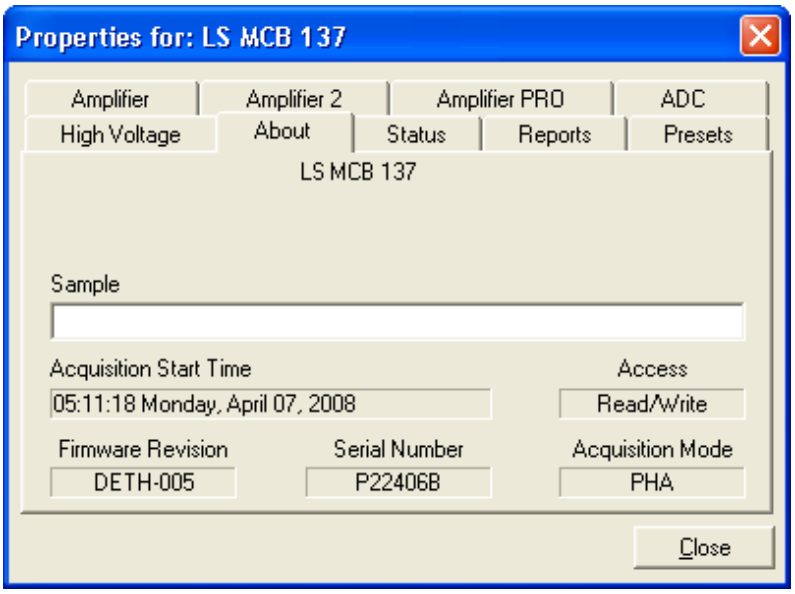

Figure 84. About Tab.

Use the **Firmware Revision** field to determine the instrument type and firmware version. This parameter is formatted *DETX-nnn*, where *X* is *H* for the Micro-Detective or *J* for the Detective-200, and *nnn* is the firmware version. In the accompanying illustration, *DETH-005* indicates a Micro-Detective running firmware v5. You can also use the About tab to view this information for .SPC-format spectra downloaded from the Detective.

8.3.7. Status

Figure 85 shows the Status tab. Ten parameters are continuously monitored in real time. Satisfactory status is reported as OK or a numerical value. A failure is reported as ERR or a descriptive message. Use the listboxes to select any six parameters to be displayed simultaneously on the Status tab. You can change the selected parameters at any time.

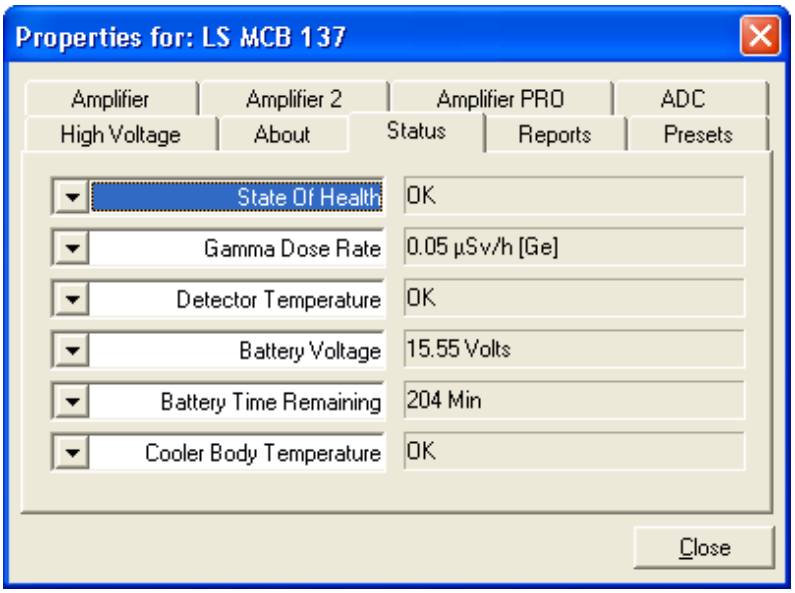

Figure 85. Status Tab.

The monitored parameters are:

- Detector **State of Health** — reported as OK or ERR.
- **Gamma Dose Rate** — reported in µSv/h, and indicating whether this reading was made with the detector (Ge for low dose rates) or the Geiger-Müller tube (GM for high dose

rates). See **Gamma Dose-Rate Determination**, page 87, for further discussion of the two dose-rate meters.

- **Detector Temperature** — reported as OK or ERR.
- **Battery Voltage** — reported in volts.
- **Battery Time Remaining** — in minutes.
- **Cooler Body Temperature** — OK or ERR.
- **Cooler Drive Voltage** — OK or ERR.
- **Cold-Tip Temperature** — OK or ERR.
- **HV Bias** — in volts.
- **ID Table Version** — reports the identification table version and release date.

To resolve status problems, refer to the troubleshooting chapter. For further assistance, contact your ORTEC representative or our Global Service Center.

8.3.8. Reports

This tab (Fig. 86) displays the reports available for the current spectrum file or live spectrum, including the ID, Found Nuclides, Suspect Nuclides, Top Lines, and (for units so equipped) GPS reports. You must be running MAESTRO or other ORTEC programs that use CONNECTIONS v6.09.06 or later.

When using the Detective as an MCA controlled by the host computer, be sure to click the **Refresh** button for each report to ensure you are seeing the most current data.

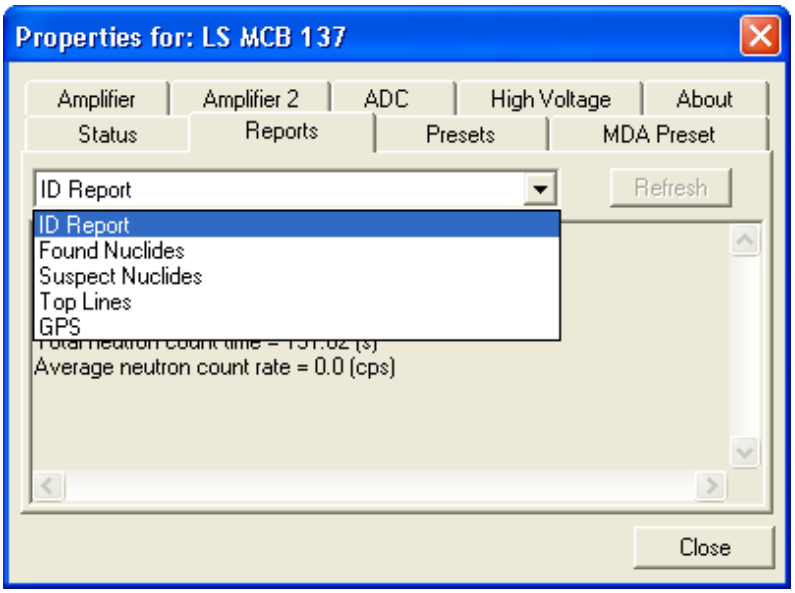

Figure 86. Reports Tab.

For more information on the contents of these reports, see Section 5.1.6.

8.3.9. Presets

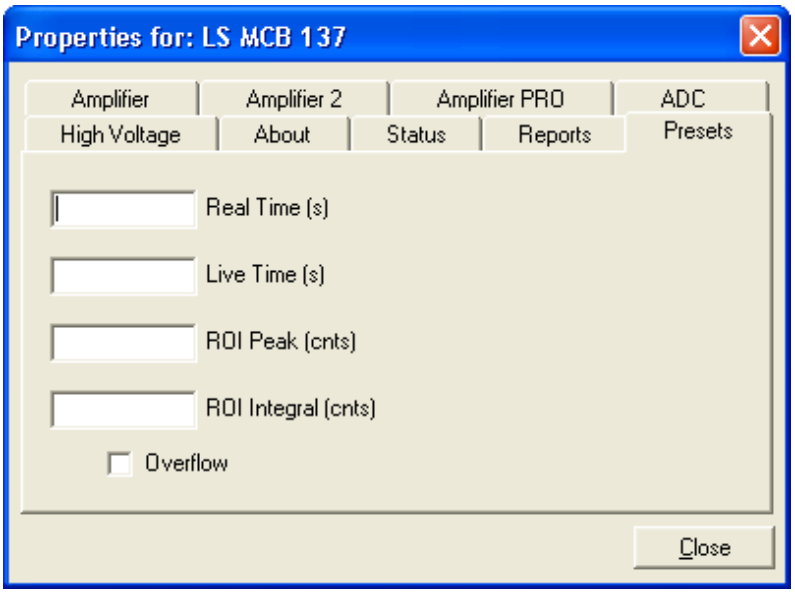

Figure 87. Presets Tab.

Figure 87 shows the Presets tab. The presets can only be set when the Detective is not acquiring data (during acquisition the preset field backgrounds are gray indicating that they are inactive). You can use any or all of the presets at one time. To disable a preset, enter a value of zero. If you disable all of the presets, data acquisition will continue until manually stopped.

When more than one preset is enabled (set to a non-zero value), the first condition met during the acquisition causes the MCB to stop. This can be useful when you are analyzing samples of widely varying activity and do not know the general activity before counting. For example, the **Live Time** preset can be set so that sufficient counts can be obtained for proper calculation of the activity in the sample with the least activity. But if the sample contains a large amount of this or another nuclide, the dead time could be high, resulting in a long counting time for the sample. If you set the **ROI Peak** preset in addition to the **Live Time** preset, the low-level samples will be counted to the desired fixed live time while the very active samples will be counted for the ROI peak count. In this circumstance, the **ROI Peak** preset can be viewed as a "safety valve."

The values of all presets for the currently selected MCB are shown on the Status Sidebar. These values do not change as new values are entered on the Presets tab; the changes take place only when you **Close** the Properties dialog.

Enter the **Real Time** and **Live Time** presets in units of seconds and fractions of a second. These values are stored internally with a resolution of 20 milliseconds (ms) since the MCB clock increments by 20 ms. *Real time* means elapsed time or clock time. *Live time* refers to the amount of time that the MCB is available to accept another pulse (i.e., is not busy), and is equal to the real time minus the *dead time* (the time the MCB is not available).

Enter the **ROI Peak** count preset value in counts. With this preset condition, the MCB stops counting when any ROI channel reaches this value unless there are no ROIs marked in the MCB, in which case that MCB continues counting until the count is manually stopped.

Enter the **ROI Integral** preset value in counts. With this preset condition, the MCB stops counting when the sum of all counts in all channels for this MCB marked with an ROI reaches this value. This has no function if no ROIs are marked in the MCB.

Marking the **Overflow** checkbox terminates acquisition when data in any channel exceeds $2^{31}-1$ (over 2×10^{9}) counts.

[Intentionally blank]

9. SPECIFICATIONS[15]

Gamma-Ray Detector Internal, coaxial HPGe detector. P-type high-purity germanium. Nominal 50 mm diameter × 30 mm deep for the Micro-Detective; nominal 85 mm diameter × 30 mm deep for the Detective-200.

Neutron Detector (on Micro-Detectives so equipped) Single PDT ^{3}He tube, 1.3 cm × 10.1 cm active length, 20 atm, inside high-density polyethylene moderator, .3.3 cm × 3.3 cm × 14 cm.

Internal Compensated Geiger-Müller Tube LND 7149 Geiger Müller tube. GM tube specifications are available on request.

Gamma Dose-Rate Determination Visual overrange indication and continuous audible alarm at dose rates >10000 μSv/h.

The Detective uses two detectors to determine the gamma dose rate over a wide range from <0.05 μSv/h to >10000 μSv/h, a dose-rate range of around six decades. For low dose rates (below ~20 μSv/h) the dose rate is determined from the Ge detector spectrum. For dose rates above this value, the internal compensated GM tube is used. The Detective switches between the two automatically.

For radiation fields from extended sources (e.g., from a container full of NORM) or far-field point sources (>1 ft [0.3 m] from the instrument), the precise location of the detector in use is not important. When point sources are close to the instrument, the detector readings might not be in agreement because they are in different places within the instrument and the dose rate is varying rapidly with position. It will be different at these two detector locations.

NOTE The dose rate function in the Detective should not be considered as adequate for accurate dosimetry purposes. Its primary purpose is to protect the user of the Detective from high radiation fields.

If you must test the dose-rate measurement capability with a point source, especially at close range, it is important to know the reference points of the instrument detectors, since test procedures such as ANSI or IAEA prescribe use of point sources at specified distances from the reference point of the instrument. Figure 88 shows the reference points for the Micro-Detective. For the HPGe detector, the reference point is the geometric center of the HPGe detector endcap disk. For the GM and neutron detectors, the reference point is shown in Fig. 88 and is marked on the case of the instrument. Figure 89 shows the reference points for the HPGe detector and GM tube; note that they are not marked on the case.

[15]Subject to change without notice.

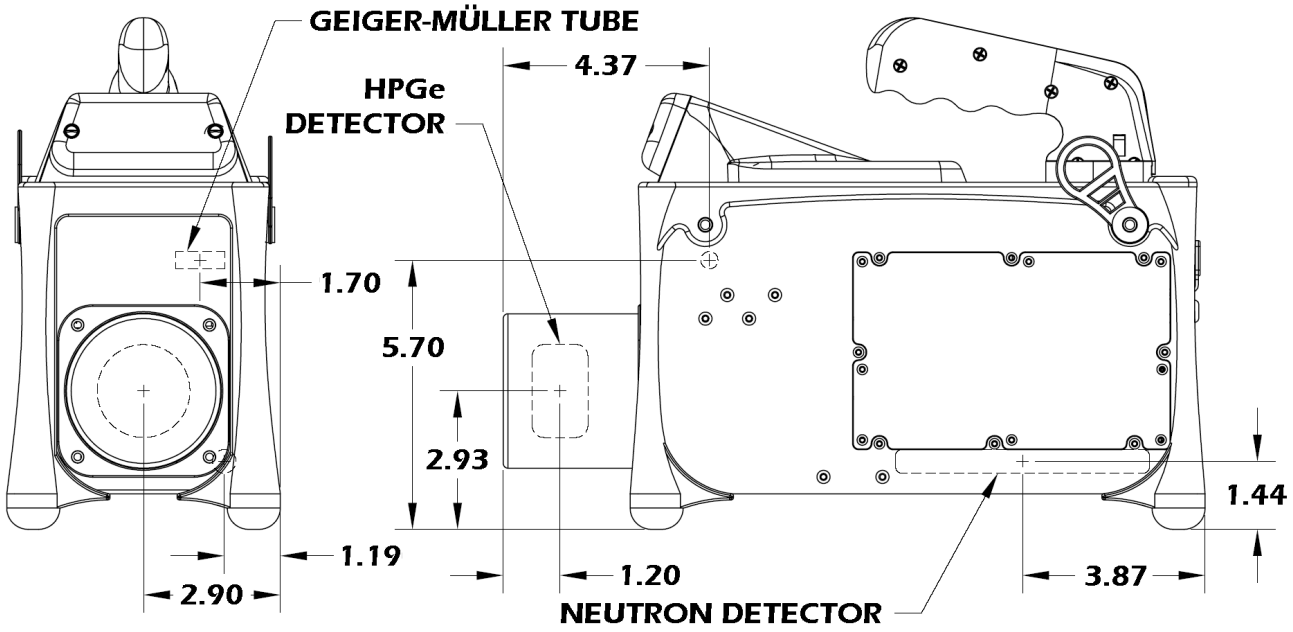

Figure 88. Micro-Detective Reference Points for the HPGe and Neutron Detectors and Geiger-Müller Tube (all measurements in inches).

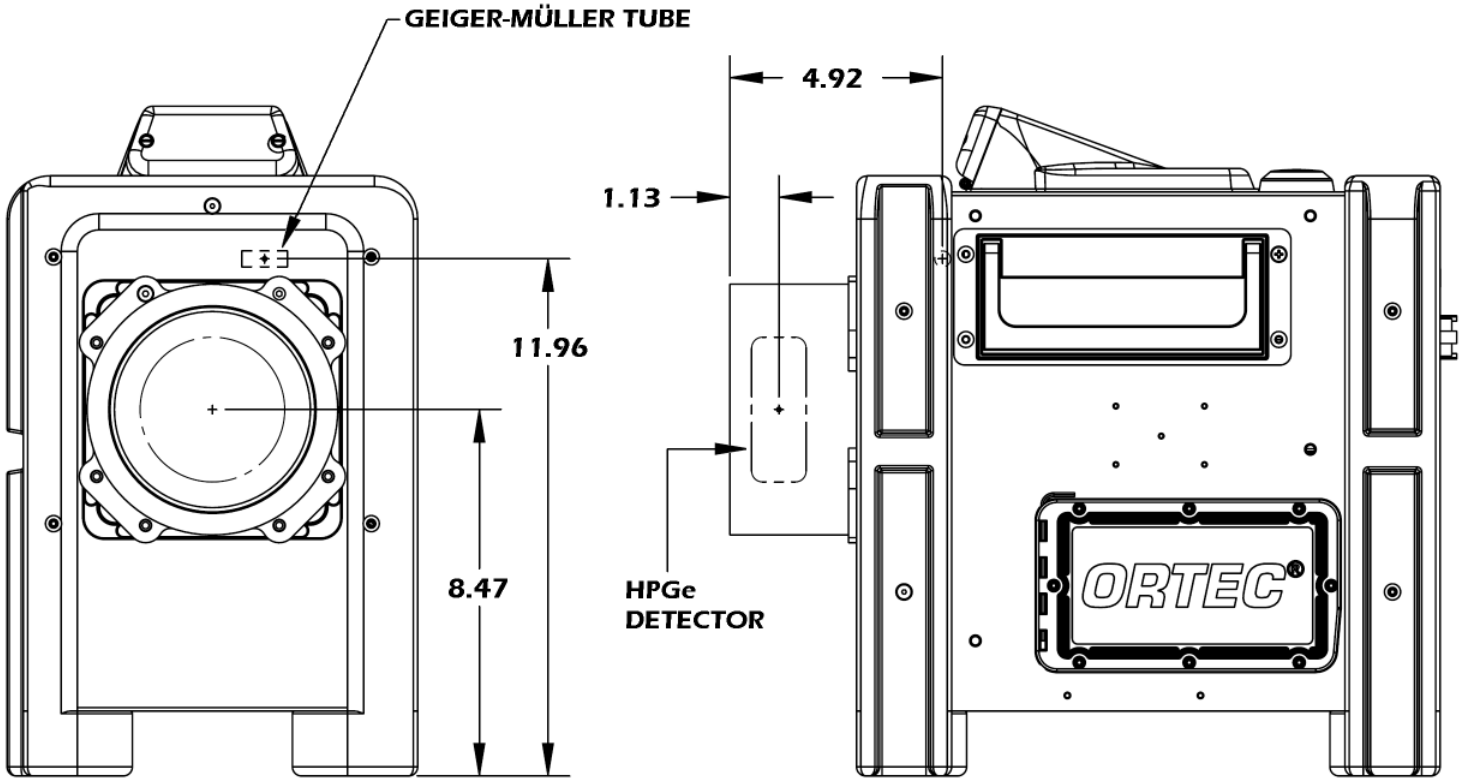

Figure 89. Detective-200 Reference Points for the HPGe Detector and Geiger-Müller Tube (all measurements in inches).

Cooler High-reliability, low-power Stirling cooler, dual-piston design, 1 W nominal lift at 100 K. Initial cooldown time depends on ambient temperature, but at 25°C is typically <12 hours for the Micro-Detective and <24 hours for the Detective-200.

GPS Internal NMEA-compliant WAAS-capable.

Wireless Communication Built-in IEEE 802.11b wireless hardware; third-party software can be used to implement this option.

Stored-Spectrum Memory The Detective can store search and spectrum files on removable SecureDigital cards.[16] The number of spectra stored on an individual card depends on the card capacity. The instrument is shipped with a 4 GB card.

System Conversion Gain In the default identifier mode, the Detective operates at a fixed conversion gain of 8192 channels. In MCA Mode, the conversion gain can be set from 512 to 16384 channels.

Shaping-Time Constants

- Rise time: Default Mode: 3.4 μs, fixed. MCA Mode: 0.8 μs to 23 μs.
- Flattop: Default Mode: 0.8 μs width, fixed. MCA Mode: 0.3 μs to 2.4 μs width.

Dead-Time Correction Extended live-time correction according to Gedcke-Hale method.[17] Accuracy: area of reference peak changes <±3% from 0 to 50000 cps.

Linearity

- Integral Nonlinearity: <±0.025% over top 99.5% of spectrum, measured with a mixed source (^{55}Fe at 5.9 keV to ^{88}Y at 1836 keV).
- Differential Nonlinearity: <±1% (measured with a BNC pulser and ramp generator).

Overload Recovery At maximum gain, recovers to within 2% of rated output from ×1000 overload in 2.5 non-overloaded pulse widths (measured using our InSight™ Virtual Oscilloscope).

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[16]Note that the computer also has a CF type II CompactFlash slot. However, the dust cover, which must be in place to prevent contaminating the card slots, blocks full insertion of the CF card.

[17]Ron Jenkins, R. W. Gould, and Dale Gedcke, *Quantitative X-Ray Spectrometry* (New York: Marcel Dekker, Inc.), 1981, pp. 266–267.

Pulse Pileup Rejector Automatically set threshold. Pulse-pair resolution typically 500 ns.

Low Frequency Rejector (LFR) Filter[18] The digital signal processor incorporates ORTEC's exclusive LFR filter, designed to reduce microphonic and low-frequency periodic noise from germanium detector output signals, thereby producing significant improvement in spectrum resolution. The LFR is specifically beneficial in systems cooled by mechanical coolers, which are known to often contribute microphonic noise to the spectrum (thereby degrading spectral resolution). The LFR is also capable of reducing any periodic noise signal resulting from surrounding electronics and equipment or ground loops.

Presets Multiple presets can be set within MAESTRO for any or all of the following:

- **Real Time** Stops data collection when the real time reaches this value (in increments of 1 s).
- **Live Time** Stops data collection when the live time reaches this value (in increments of 1 s).
- **ROI Integral** Integral count stops data collection when the sum of all ROI channels reaches this value.
- **ROI Peak** Peak count stops data acquisition when any ROI channel reaches this value (maximum value of $2^{32}-1$ counts [4×10^9]).
- **Data Overflow** Terminates acquisition when data in any channel exceeds $2^{31}-1$ (2×10^9) counts.

9.1. Electrical and Mechanical

Dimensions Maximum overall dimensions including handle, Ge detector endcap, neutron detector and shock absorbers.

- **Micro-Detective** 37.4 cm L × 16.6 cm W × 27.9 cm H (14.7 in. × 5.8 in. × 11 in.)
- **Detective-200** 42.7 cm L × 24.1 cm W × 38.7 cm H (16.8 in. × 9.5 in. × 15.2 in.)

Weight

- **Micro-Detective** 6.9 kg (15.2 lb)
- **Detective-200** 21.3 kg (47 lb)

[18]Patent pending.

Maximum Shock Tolerance 20 g. An accelerometer inside the instrument tracks the maximum shock to which the Micro-Detective or Detective-200 has been subjected, and a shock in excess of 20 g will void the warranty.

Ambient Operating Environment –10°C to +40°C, at a relative humidity <90% at 35°C, non-condensing.

Internal Battery Rechargeable, nominal 14.4 V lithium-ion battery pack. Charging circuitry and battery management circuitry internal to the power adapter/charger. Battery lifetime 3–5 years; replacement kit available from ORTEC. The compartment is semi-sealed and protects against penetration of dirt and moisture. See Chapter 10 for instructions on replacing the battery.

Battery Life When HPGe detector is cold, >3 hours at 25°C for the Micro-Detective and >2 hours at 25°C for the Detective-200. <4 hour charge time. Battery life can be extended indefinitely by the use of optional, external battery belt. The unit is expected to be kept running once cold.

Note that the internal battery charge can start the mechanical cooler but cannot fully cool a warm detector; external power is required. In addition, an exhausted internal battery should be charged for 2 hours before the identifier is cooled using external power. If the internal battery is completely exhausted but can still hold a charge, see troubleshooting Section 7.4. Note that using an automobile battery to cool the detector could significantly discharge the auto battery.

Power Usage Greatest during cooldown: <100 W. While charging battery: 5 A nominal. Cold with fully charged battery: <2 A.

CE Conforms to CE standards for radiated and conducted emissions, susceptibility, and low-voltage power directives.

9.2. Connectors

USB ( ) Rear-panel Universal Serial Bus connector, with dust cover, for communication with computer for file transfer with the **Data (ActiveSync)** setting and for use as an MCA with the **Control (MCA Mode)** setting.

Headphones ( ) Micro-Detective only. Rear-panel female connector, with dust cover, accepts standard male headphone jack. Headphone volume controllable from the touchscreen. Note that the audible high-dose-rate alarm sounds whether or not headphones are connected to the unit. This alarm is not routed through the headphones and its volume is independent of the headphone volume setting.

INPUT POWER

- **Micro-Detective** Rear-panel external power input, with dust cover, 12–17 V dc, 60 W, or from battery or ac power adapter/charger.

- **Detective-200** Rear-panel external power input, with dust cover, 12–17 V dc, 30 W, or from battery or ac power adapter/charger.

9.3. Computer Prerequisites

In addition to completely independent, standalone operation, both Detective units can also be operated as a benchtop MCA, in conjunction with ORTEC CONNECTIONS software such as MAESTRO, by connecting them to the USB port of any computer running Microsoft® Windows® 8, 64- or 32-bit Windows 7 Professional, or Windows XP Professional SP3.

9.4. Shipping the Micro-Detective or Detective-200

To avoid damaging the cooler and, where applicable, to comply with transportation regulations, be certain to turn the cooler off before shipping the Detective. To do this, tap **Advanced** in the Survey Mode dialog, then **Turn Cooler OFF**. The unit can be shipped as soon as the cooler is turned off. There is no need to wait until the detector warms up.

9.5. Long-Term Shutdown/Storage

CAUTION

This instrument should be cooled and brought to operational status (Status: Ready) for at least 48 hours every month. Failure to do this may result in degraded performance or cooling system failure.

This instrument uses a Stirling cycle refrigerator and all-metal-sealed cryostat designed for long operational life. The vacuum integrity inside the cryostat is maintained by "getters," which scavenge traces of residual material when cold; and by an ion pump that operates when the instrument is powered up. These two techniques maintain the system vacuum in peak condition during normal use. A good vacuum yields rapid cooldown and ensures operation at the high end of the instrument's operating temperature range.

Over time, in any cryostat system, residual contaminants can be released from the materials inside the evacuated cryostat by a process called *outgassing*.[19] It has become apparent that, in

[19]This is not to be confused with a vacuum leak, although both result in a degradation of the vacuum.

extended storage, the vacuum in our mechanically cooled identifiers may degrade to the point that, on trying to restart, the gas load inside the cryostat is too high and the unit fails to cool. The remedy is reasonably straightforward, if inconvenient: a “pump and bake” of the instrument is required at an ORTEC service center. Fortunately, you can easily avoid this problem:

We strongly recommend that instruments used only occasionally be turned on once a month, fully cooled to Ready status, and allowed to run for at least 48 hours. Doing this starts the ion pump and activates the internal getters, ensuring that the vacuum is maintained in good condition.

As well as maintaining the vacuum, this procedure keeps the system battery “topped up” and also provides peace of mind that the system will cool when required.

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10. CHANGING THE INTERNAL BATTERY

The typical service life of the Detective's 14.4 V lithium ion battery is 3–5 years. When the internal battery no longer retains a charge, it must be replaced with the appropriate ORTEC battery replacement kit. This is a straightforward operation that takes just a few minutes, so the detector does not significantly warm up during the procedure. When connected to external power, the detector will be cooled to operating temperature first, then the new battery will charge, typically reaching full charge within 3–4 hours. For more information, contact your ORTEC representative or our Global Service Center.

1) If external power is available, connect the Detective to the power source.

2) Shut down the computer by pressing and holding the on/off button for 1–3 seconds to display the power menu, then tapping the **Shutdown** option.

3) Figure 90 shows the quick-release battery hatch. The two release latches are located on the top edge. Slide the latches up and open the hatch as shown in Fig. 91.

Figure 90. Quick-Access Battery Hatch, Closed.

4) For older units with bolt-on hatches, use the supplied 3/32-inch hex-head wrench (stored on the left side of the hatch, as shown in Fig. 92) to loosen the hatch's eight (8) captured screws, and remove the hatch to expose the battery.

5) The end of the battery closest to the HPGe detector endcap has a pull tab. Gently pull it outward, as if opening a book cover or door, until the battery slips off the connector terminals at the lower rear of the compartment. Figure 93 shows the pull tab on the front side of the battery and the connector terminals on the lower back edge.

6) Guide the new battery onto the connector terminals and press it into place, then close the hatch and slide the latches closed. (For older units, replace the bolt-on hatch and ***do not overtighten the screws***.)

Figure 91. Quick-Access Latches Up and Hatch Open.

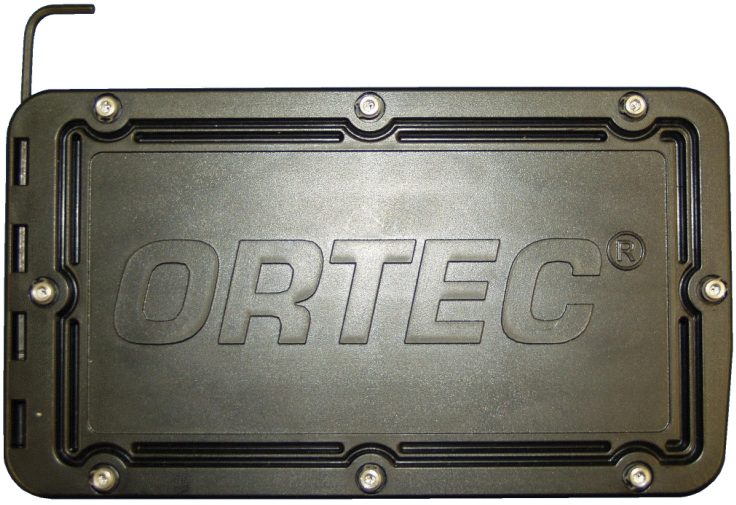

Figure 92. Battery Hatch With Hex-Head Wrench in Holder.

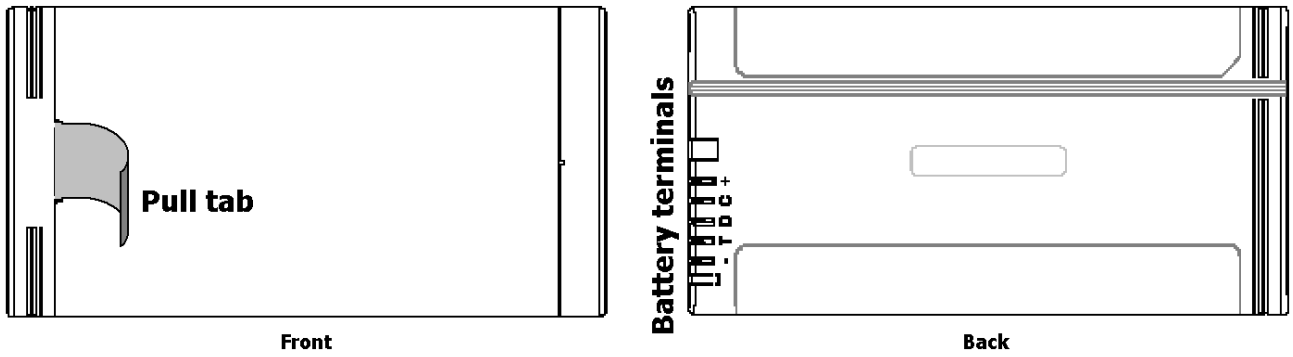

Figure 93. Front and Back of Internal Battery.

7) Restart the Detective by pressing the on/off button, then wait for the Detective program to start and fully initialize. If you did not turn the cooler off, it will restart by itself.

   — If the Detective was connected to external power when you changed the battery, simply wait for its status to change to Ready, and return it to service.

   — If the Detective was *not* connected to external power, the computer must reboot before the Detective program starts. Once the program is fully initialized, wait another 5 minutes for any alarms to clear. Typical alarms may include a warm detector error, a detector bias voltage error, and/or a detector gain stabilizer error. If a gain stabilizer error is posted, wait another 5 minutes to see if it clears. If it does not, run a background measurement.

8) Return the old battery to ORTEC for recycling.

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INDEX

Administrator Mode
- advanced setup 41
- hiding the spectrum display 56
- password 56

Alarms
- dose-rate and count-rate 59
- MOVE BACK 17
- RDD 40, 59

Audio volume 59
Background measurements 53
- final (mandatory) step in calibration 22
- ID and Monitor Modes disabled 15
- invalid background 15
- minimum data collection time 46, 54
- performing the background measurement . . . 46
- required after manual calibration 45

Battery 13
- cannot cool detector 43
- exhausted, startup from 70
- replacing 10, 95

Calibration check 19, 43
- auto-calibration 51
- manual 43
- new background required 21, 22, 45
- troubleshooting 71
- user-defined sources 51

Calibration source 19
- user-defined 51

Cautions 13
Connecting to a PC 75
- using MAESTRO 77

Cooler
- cautions 14
- detector warmup 92
- power sources 13
- power-up 16
- restarting 16
- shipping 92
- shipping preparations 14
- shock tolerance 14
- shutdown for brief periods 43
- shutdown for long periods/storage 14, 92
- startup 43

Data transfer to PC 57
Detective-200 12
- amplifier settings 78-80
- battery replacement 10
- components 9
- connectors 10, 12, 15
- exhausted battery, startup from 70
- features, illustrated 12
- front panel 9
- GPS 57
- high-voltage setup 81
- identification reports 83
- Monitor hardware status 82
- On/Off button 9
- operating cautions 13
- presets 84
- shock tolerance 14
- software and firmware versions 50
- status screen 42
- temperature and humidity specifications 14
- use as conventional MCA 73
- weight/nose-heavy cautions 12

Display Mode 29
- hiding the spectrum display 56

Dose- and count-rate limits 24, 59
Dose-rate detector
- reference points 88

Exit 60
File transfer to PC 63
Gamma count rate meter 23
Gamma dose rate 24
- dose-rate units 59
- rate meter display 23
- setup and defaults 59

GPS (global positioning) 4
- GPS report 49
- latitude/longitude indicator 23
- specification 89
- troubleshooting 72

Hardware status 41
Identification Mode
- identification (.SPC and .N42) files 6, 27
- monitoring for radionuclides 25

InSight Mode 79
Launcher program 7, 8
LCX (low-confidence expert) Mode 55
MAESTRO 5, 63
  MCB Properties setup 77
  monitor detector state of health 82
  presets 84
  troubleshooting 73
MCA Mode 57, 75
Menus
  navigation 17
Micro-Detective 9
  amplifier settings 79, 80
  battery replacement 10
  carrying strap 11
  components 9
  connectors 10, 15
  exhausted battery, startup from 70
  features, illustrated 10
  front panel 9
  GPS 57
  high-voltage setup 81
  identification reports 83
  Monitor hardware status 82
  On/Off button 9
  operating cautions 13
  presets 84
  shock tolerance 14
  software and firmware versions 50
  status screen 42
  temperature and humidity specifications 14
  use as conventional MCA 73
Monitor Mode
  portal monitoring 31
  rapid surveys 31
Neutron count rate 59
Operating cautions 13
Password
  enter to change settings 50, 51
  set password 56
Power
  exhausted battery, startup from 70
  internal vs. external 13
Power adapter/charger
  cautions 13
  power 13
Quantitative analysis 76
RDD Detected message 40
Reference point (detector) 88
Remote screen 60
Reports
  found nuclides 27, 48
  GPS 83
  GPS location data 49
  ID report 48
  suspect nuclides 27, 49
  top lines (most intense) 28, 49
  viewing stored spectra and reports 46, 47
Restricting access to settings 56
Search Mode 3
  "strip chart" (.CHN and .N42) files 7
  dwell time per channel 57
  monitoring count rate 30
Shipping 14, 92
Shutdown for long periods/storage 14, 92
SNM Search Mode 3, 32
  setup 57
Spectrum
  delete stored spectra 62
  Display Mode 29
  enter a description 61
  file storage location 61
  file transfer to PC 63
  filename formats 61
  hiding the spectrum display 56
  identification (.SPC and .N42) files 6, 27
  quantitative analysis 76
  search (.CHN) files 30
  stored (saved) spectra 5
  transfer to PC 57
  viewing stored spectra and reports 46
  zoom, marker, scaling 29
Survey Mode 1
  passive monitoring 23
Troubleshooting 69
Windows connectivity
  troubleshooting 72
  Windows 7 (Mobile Device Center) 63

XP (ActiveSync) 65
Wireless communication (IEEE 802.11) 89

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